EDITORIAL SUPPLEMENT
(Including Classified Advertisements)

NOVEMBER 3, 1950

THE ENGINEER

A Seven-Day Journal

THIS SUPPLEMENT

Owing to that dispute in the London printing trade, to which we have already made several editorial references, our printer's compositors are not at work. One of the consequences is that the number of pages in each issue of THE ENGINEER has had to be much reduced. Another, less obvious, consequence is that very little new matter can be set up in type by our printers. Under these circumstances, we have been forced to draw heavily upon stocks of articles already in type at the time when the development of the dispute brought printing in the London area almost to an end. But stocks, like a "dollar reserve" cannot be drawn down too far, nor can they be drawn upon indefinitely. We have, therefore, now been forced to reduce still further the editorial contents of the issue to which this is a Supplement. As a further consequence of the situation, THE ENGINEER has been unable for the past month adequately to report current engineering events. Nor has it been possible adequately to pass on to readers information received at our office about new products, new methods etc. A means of remedying that situation, at least in part, has now been found. This Supplement has been produced by a method independent of the services of our printer's men. It is our intention, unless the dispute in the London printing trade comes to a speedy end, to issue such a Supplement weekly. What appears in it will be principally confined to material that requires publication as soon as possible after the event to which it relates or which is descriptive of some new product or process. The Supplement will also contain, as does this one, "Classified Advertisements." It will be sent direct to subscribers by post, and will be included in any copy of THE ENGINEER sold "over the counter."

RETIREMENT OF MR. J. M. ORMSTON C.B.E.

Mr. J.M. Ormston C.B.E., the director and general manager of Vickers-Armstrongs Naval Yard, High Walker retired at the end of October. Mr. Ormston, who was born at Low Fell, Gateshead, served his apprenticeship at the Elswick shipyard of Sir W. G. Armstrong Whitworth and Company Ltd. and studied naval architecture at the Royal Naval College, Greenwich, as a private student. Upon the completion of the course he was appointed assistant manager at Elswick. Following a short period spent on the Clyde, he then joined Cammell Laird and Co. Ltd. as repair manager and later was appointed shipyard manager. In 1925 Mr. Ormston became the assistant general manager of the Singapore Harbour Board and after two years' service he returned to England to join Vickers Ltd. at Barrow. Three years later he took charge of the Walker Naval Yard and, upon the closing down of the yard in 1932, returned to Barrow as shipbuilding manager. In 1942 he was appointed a director of the company and returned to the Walker Naval Yard to take up the duties of general manager. After the war, Mr. Ormston carried through a complete reconstruction of the yard which is now laid out for welded construction and for prefabrication, and in addition he was responsible for introducing the comprehensive apprentice training scheme and vocational school in the yard. Mr. Ormston, who was made an M.B.E. after the first world war and awarded the C.B.E. in 1949, was also a director of Palmers Hebburn Company Ltd. He is past-president of the Shipbuilding Employers' Federation and has served as a member of the Tyne Improvement Commission. Consequent upon Mr. Ormston's retirement, Vickers-Armstrongs Ltd. has stated this week that Mr. C. W. Moss, shipbuilding manager at Barrow, has been appointed a director of the company and deputy general manager of the Barrow works and shipyard.

NATIONAL DIPLOMA IN AGRICULTURAL ENGINEERING

Further recognition of the growing importance of agricultural mechanisation in Britain and throughout the Commonwealth is given by an announcement that the Institution of British Agricultural Engineers has instituted an examination for a National Diploma in Agricultural Engineering. Candidates holding the diploma will be eligible for graduateship of the Institution, and those who conform to the requirements of age, practical training and experience will qualify as Associate Members. Up till now, there has been little provision - apart from the post-graduate course at King's College, Newcastle-upon-Tyne - for training in agricultural engineering. The syllabus which has now been produced by the Institution of British Agricultural Engineers, after many months of careful investigation and discussion by its education committee, will undoubtedly provide a common examination standard for technical colleges, agricultural colleges and universities. Possession of the diploma will obviously afford a status for agricultural engineers comparable with that conferred by membership of other professional bodies. The examination covers agricultural engineering, agricultural science or engineering science, and a choice of two of the following subjects:- field engineering, farm buildings and mechanisation, crop production and mechanisation, and agricultural engineering design. The first examination will be held in 1951 and particulars can be obtained from the Institution of British Agricultural Engineers, 24 Portland Place, W.1.

SHIPS' NAVIGATIONAL AIDS

The Working Party set up in 1946 by the Ministry of Transport to review the existing arrangements for ships' navigational aids, other than radio, has now issued its report, in which recommendations are made concerning ships' compasses, depth sounding devices, and the lighting of chart rooms. The Working Party, consisting of members from the Ministry of Transport, the Admiralty, organisations of shipowners, ships' officers and men, and the nautical instrument trade, has aimed at producing a code of practice acceptable to all interests, and allowing scope for progress in design, competitive variety and improved methods. The minimum standards set out in the report for the provision and maintenance of compasses in sea-going ships, such as the fitting of two magnetic compasses, testing at the Admiralty Compass Observatory, and siting to avoid magnetic interference are already in practice. A specification, which is to be adopted by the British Standards Institution, has been produced to cover quality and performance of magnetic compasses. In addition, conditions governing the issue of certificates to compass adjusters and the examination syllabus have been set out. The report also recommends that, subject to a tonnage limit, there should be one mechanical sounding device and two hand lead lines, and as night vision is temporarily impaired by exposure to a white light, orange lighting is proposed for chart rooms.

The Fifteenth Commercial Motor Show - No.IV

(Continued from page 361, Oct. 13th, 1950)

We resume our report with an account of some of the technical improvements relating to major vehicle components and some of the more interesting proprietary units, such as engines and transmissions.

Engines

In the case of heavy commercial vehicles, the Diesel engine of something between 8 and 11 litres capacity is the almost universally used power unit, but there is sufficient evidence to show that its more general application to vehicles of a smaller payload capacity is well on its way. In any case practically all British manufacturers have adopted, for engines of more than 100 mm cylinder bore, the direct injection system which undoubtedly gives the highest thermal efficiency and the best cold starting. It has been suggested that specific overseas demands might lead to a revival of the air-swirl or precombustion-chamber engine because of its insensitivity to widely differing fuels and, further, because the single-hole pintle-type nozzle could run for longer periods without attention. These predictions have not proved to be correct; on the contrary, the necessity for optimum fuel economy seems to be the most important factor all over the world and difficulties, previously experienced with multi-hole nozzles, have been overcome to a great extent. Today all British direct-injection Diesel engines have the combustion chamber formed in the piston and depend, for satisfactory distribution and combustion of the injected fuel, on an organized, essentially rotary, air swirl, produced by suitably shaped inlet ducts or masked valves.

Comparatively few changes are apparent in the general layout of modern British Diesel engines. The necessity of keeping the overall length of the engine small, has led to very short main bearings, subjected to relatively high loadings. Lead-bronze or copper-lead bearings on steel backings (frequently treated with an electrically deposited flash of indium) have generally given the best all-round results in conjunction with nitrided or induction-hardened crankshafts. Experiments with cast-iron crankshafts have not given entirely satisfactory results but cast camshafts are widely used. Cylinder liners of hard centrifugally-cast iron are now universal with a pronounced tendency in favour of the dry liner. The dry liner, seated in the bore of the integral block with slip fit, does away with the vulnerable rubber sealing rings, it can easily be replaced without removing the engine from the chassis, and greatly facilitates the design of a stiff and rigid cylinder block.

Chromium plating of the cylinder bore is still an exception (used by Commer Cars Ltd. in their six-cylinder 4-litre petrol engine) but the chromium plating of the top piston ring, sometimes of the two uppermost piston rings, is now accepted practice, and has been found extremely useful in reducing cylinder wear. Renewable valve-seat inserts of heat-resisting material, such as chrome iron, screwed or frozen into the cylinder head, are frequently used, and so are stellite-faced exhaust valves. Further, there seems to be a tendency to replace the chain drive for camshaft, injection pump, and other auxiliaries by a train of helical gears; this arrangement is particularly effective, though expensive, if the drive is taken from the flywheel end of the engine.

Much of to-day's success with new types of Diesel engines, as far as injection and combustion are concerned, is due to the continuous improvements made in the design and production of the injection equipment. The "N"-type fuel injection pump with the all-speed hydraulic governor, first introduced two years ago by C.A.V., Ltd, is at present only to be seen on the Foden two-stroke engine. but the experience gained with these units has enabled successful large-scale production to be started. Mention may be made of the continued success achieved with the pneumatic governor, particularly for small engines and for applications where closeness of control is less important than low cost.

Of the various methods which have been tried in order to eliminate the "Diesel knock", caused by the time-lag between the injection of the first fuel particles and their actual ignition, the most practical and least expensive method is that of pilot injection, manufactured by C.A.V. Ltd. This system includes a special pump with a two-stage cam profile, a special pressure-responsive delivery valve, and a double differential nozzle. They make it possible to start the injection with a pilot-charge of low pressure and rate of delivery, keeping the combustion under control so that the pressure rise is more gradual and "Diesel knock" is practically eliminated.

The demand for underfloor engines has confronted the designer with some rather intricate problems, mainly those concerning the arrangement of injectors, injection pump, oil filter, etc. in such a way that they are easily accessible for service and maintenance. In its general layout, however, the construction of the underfloor engine closely follows the lines of the equivalent vertical types and, wherever possible, current vertical engine components are being utilised to facilitate production and service.

The new six-cylinder horizontal Diesel engine shown by L. Gardner & Sons Ltd. has 108 mm bore and 152 mm stroke, giving a swept volume of 8.4 litres and developing 112 h.p. at 1700 r.p.m. In most respects it follows the same traditions as the other Gardner automotive engines, having a separate crankcase, cylinder and cylinder-heads, push-rod operated valves in the heads, and the camshaft located in the crankcase. The latter is cast in aluminium alloy and houses, in the forward end, the triple chain drive for camshaft and auxiliaries. The oil sump, one of the few major components not interchangeable with those of the vertical range of engines, is also cast in aluminium with cooling fins on the forward face. (Fig.8)

No engine-mounted radiator cooling fan is fitted but the engine is arranged for driving a remote radiator-mounted fan and other auxiliaries through an extension shaft, flexibly coupled to the forward end of the engine crankshaft, or by means of a multiple V-groove pulley mounted on the crankshaft.

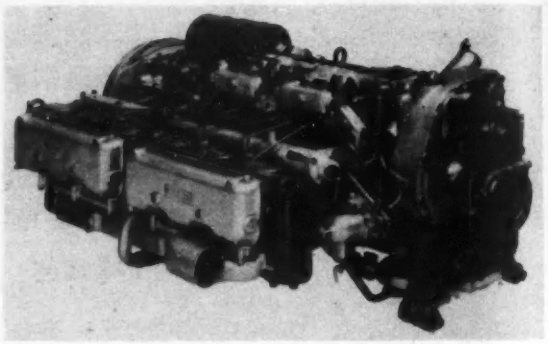


FIG.8—SIX-CYLINDER HORIZONTAL ENGINE—GARDNER

A facing at the forward end of the sump bay may be employed for dynamo mounting, as an alternative to the standard arrangement, or for mounting an air compressor, the drive being taken from the V-groove crankshaft pulley.

The design of the new A.E.C. 11.3 litre six-cylinder engine developing 150 h.p. at 1800 r.p.m. is based on that of the well-known 9.6 litre engine, having the same stroke of 142 mm, but the bore has been increased from 120 to 130 mm.

The dry-sump lubrication system of this engine is interesting: it employs two gear-type oil pumps, one for scavenge and one for pressure, both driven through helical gearing from the crankshaft. The pressure pump draws oil through gauze strainers in the engine sump, delivering it under pressure via a spring-loaded relief valve to the main and big-end bearings and to the timing gear idler wheel. Low pressure lubrication is supplied to the camshaft front bearing and valve gear; surplus oil lubricates the cam followers and the remaining camshaft bearings. Gudgeon pins, cylinder

walls and timing gear teeth are lubricated by splash from the rotating crankshaft. The scavenge pump draws oil from the lowest point in the engine casing, and returns it to the sump.

Two new engines were shown by Henry Meadows Ltd., one of which, a vertical four-cylinder 5.43 litre unit, was fully described and illustrated in "The Engineer" of September 15th. The other one, a horizontal six-cylinder engine of 10.35 litres capacity follows the Meadows practice of employing a bore-to-stroke ratio of unity, in this case 130 x 130 mm, and has a maximum output of 130 h.p. at 1900 r.p.m. This engine also makes use of the interchangeability of the major components as employed in the vertical engines, but is fitted with cast-iron cylinder-heads as against the aluminium heads of the vertical units.

An example of a very well designed vertical petrol engine is the new 5-litre Vauxhall six-cylinder overhead-valve petrol engine of 98.5 mm bore and 108 mm stroke which develops 110 h.p. at 3200 r.p.m. This engine (Fig.9) which forms the power unit of the new Big Bedford 7-ton vehicle is similar in appearance to the well-established units used in the 5-ton vehicle, but it embodies several improvements, commonly used only in the very much higher stressed Diesel engine. They include full-length cylinder liners, a seven-bearing induction-hardened crankshaft with a torsional vibration damper, copper-lead

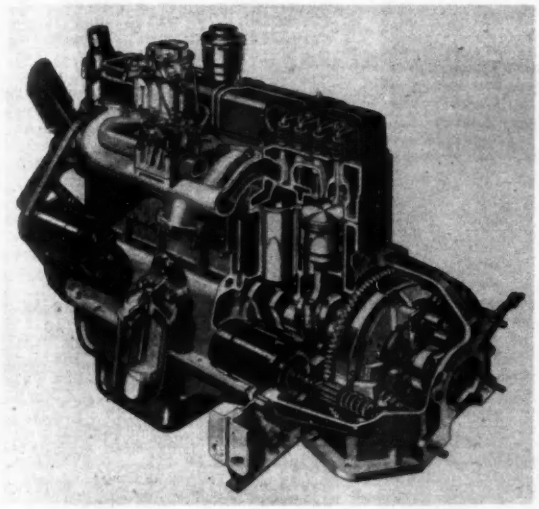


FIG.9—SIX-CYLINDER PETROL ENGINE—VAUXHALL

bearings for the mains and big-ends, and hard valve seats for the exhaust valves. The engine is fitted with a Zenith six-phase carburettor with accelerator pump and diaphragm-type part-throttle economy valve, which adjusts the richness of the mixture according to the needs of the engine. A pneumatic governor in the inlet manifold controls a spring-loaded throttle valve which is closed when the induction gases reach a predetermined velocity. Another interesting item is the positive system of crankcase ventilation which ensures a controlled flow of clean air through the engine (Fig.10). Air entering the system is filtered through an oil-bath air cleaner mounted on the rocker cover and drawn through the crankcase by the suction in the inlet manifold. A spring-loaded valve regulates the depression in the crankcase. Another oil-bath cleaner not shown in Fig.10, protects the carburettor intake.

Gearboxes

Whereas in private cars the design of the gearbox follows clearly defined and well-established principles, the problem of deciding which type of transmission is desirable for the various categories of commercial vehicles is not easy. The service requirements of city buses, coaches, delivery vans and heavy goods vehicles differ so greatly from one application to another that, so far, no general solution to the transmission problem has been found.

At present, the majority of public service vehicles in this country, still have unsynchronised gearboxes and transport operators claim that there seems to be no urgent need to relieve the skilled bus driver from the relatively simple task of gear changing. On the other hand, epicyclic gearboxes in conjunction with fluid flywheels are generally used in London Transport buses and other provincial towns with heavy traffic. The efficiency of these units, manufactured by Self-changing Gear Company Ltd., has been greatly improved lately by the introduction of the type C.V. gearbox with an air operated bus-bar. These gears, like the previous S.T.L. type, are preselected by manual control from the steering column. The driver's pedal is connected to a clutch valve which controls the admission of air to an operating cylinder within the gearbox. This air pressure acts upon a piston which in turn operates the bus-bar. This new box has improved the smoothness of acceleration and has greatly reduced the unpleasant transmission jerks associated with careless driving.

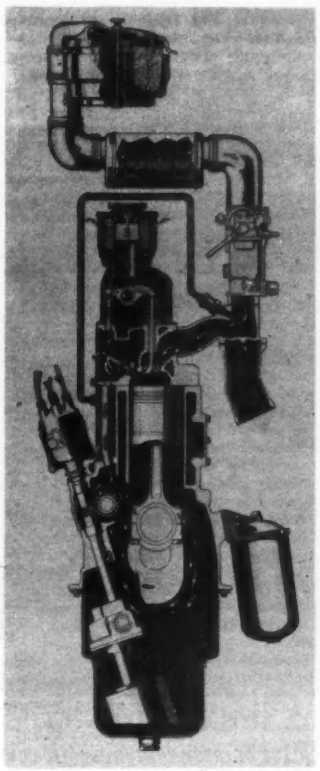


FIG.10—CRANKCASE VENTILATION—VAUXHALL

An electrically operated system providing full automatic control has now been introduced by the same manufacturers. It is to be superimposed as an auxiliary to the new range of power operated change-speed gearboxes of the non-preselective type, i.e. the type where the brakes are operated by direct air application to each individual brake band.

Its nerve centre is a centrifugal governor, driven by a V-belt from the gearbox input-shaft. The governor sleeve in its end-positions makes contact with a movable cam, connected by a rod to the accelerator pedal and therefore to the control rod of the fuel injection pump. Contact between the governor sleeve and cam takes place in accordance with the predetermined pattern based on these two variables, so that the governor is actually speed and torque responsive. Whenever the governor makes or breaks contact, the electric current, supplied from the vehicle battery, energises relays and activates solenoids (one for each individual air cylinder) which in turn open or close valves admitting air pressure to the cylinders for the operation of the brake bands. A separate control panel in the driver's cabin houses an electrically operated selector switch and relays. The latter relieve the governor switch contacts of all but a very minute current and are equipped with time-lag condensers to prevent "hunting" or oscillation of the control mechanism. A master control switch on the steering column allows manual as well as full automatic control. In the latter case the accelerator pedal alone is used to regulate the speed of the vehicle.

A new four-speed gearbox, similar in design to that fitted to the Dennis "Dominant" chassis, was seen at the stand of Hobbs Transmission Ltd. This gearbox can be described as manually controlled or

semi-automatic, inasmuch as no clutch pedal is to be operated, and gear change takes place by moving a control lever beneath the steering-wheel through a series of positions, giving reverse, neutral, first-gear, etc. All changes can be made with the throttle open, thus maintaining the tractive effort during the gear change and giving smooth acceleration without calling for any particular driving skill.

Lack of space prevents us from giving a full description of this gear but the general principles involved may be understood from the following brief account.

The complete transmission, as shown in Fig.11, embodies the following units - the actual gear unit, the clutch unit which is bolted to the flywheel and contains the two main clutches, a further unit embodying three reaction brakes, and, finally, the hydraulic unit, generating and controlling the oil pressure for the operation of clutches and brakes. The gear unit which comprises a planetary gear train has three sun-wheels which mesh with triple pinions mounted on spindles carried by the cage. The rear sun-wheel is mounted upon the output shaft, and the remaining elements of the gear train are connected with the spinner plates of the clutches and brakes.

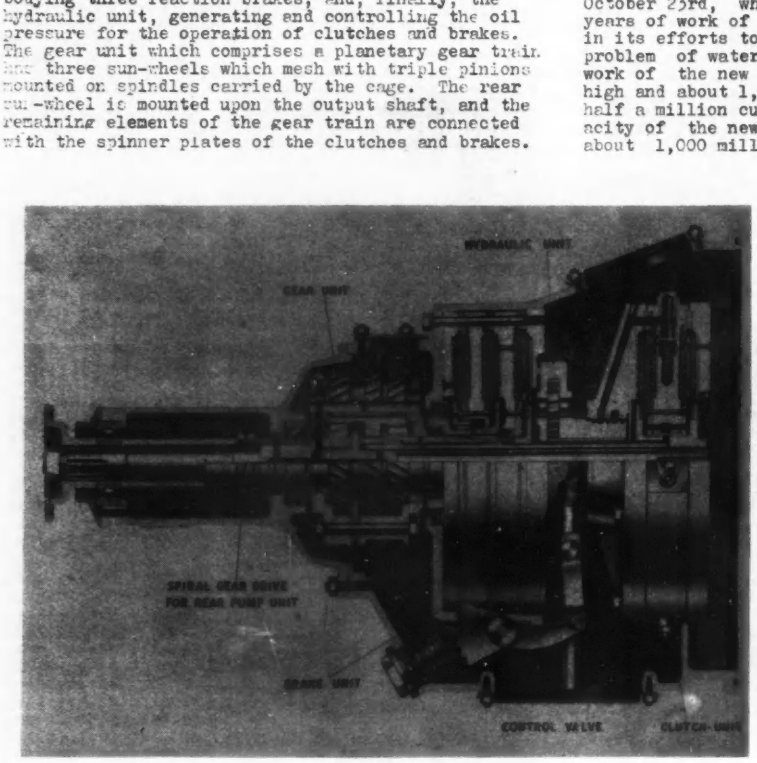


FIG.11—CLUTCHLESS GEARBOX WITH HYDRAULIC CONTROL — HOBBS

The clutches and the reaction brakes are essentially single-plate friction couplings but the friction surfaces are urged into engagement by hydraulic pressure instead of springs. For this purpose a synthetic rubber faced diaphragm covers a shallow angular space and transmits the hydraulic pressure via a heat insulating plate and an axially movable pressure plate to the friction surface of the spinner plate. To engage the clutch or the brake, oil pressure, delivered by the pump unit, is led through a control valve and ducts, to the space enclosed by the diaphragm. The pressure plate is urged in the direction to disengage the clutch by a number of springs, so that the friction surfaces will become disengaged if the oil pressure is removed from the annular space. Owing to the very large area of the diaphragm, very high engaging loads can be applied, even though the pressure delivered by the pump is relatively low, and the friction surfaces can operate in a lubricated condition. If a very high torque has to be taken up, as in the case of the two rear brakes, the friction surfaces should be sealed from oil and operated dry.

Automatic valves, fitted to the clutches and working in conjunction with the pump control valve, govern the flow to or from the diaphragm-covered annular space and limit the pressure therein, according to the necessary torque requirements. Two oil pumps of the gear-type are provided, one driven from an input part and the other from an output part. When the vehicle is stationary, the pressure is supplied by the pump driven from the input part; should the engine be stationary and the vehicle moving, the pressure is supplied by the output driven pump. During normal operation both pumps supply pressure.

(To be continued)

Opening of the Darwell Reservoir, Hastings

The Darwell reservoir at Mountfield in Sussex, was officially opened by the Duke of Norfolk on Monday October 23rd, which marks the conclusion of many years of work of the Hastings Corporation Water Dept. in its efforts to find a satisfactory solution to the problem of water supply in Hastings. The principal work of the new scheme is an earth fill dam 62 feet high and about 1,800 feet long, and containing about half a million cubic yards of fill. The total capacity of the new reservoir formed by this dam is about 1,000 million gallons, which is sufficient to afford a supply of 3½ m.g.d. under the most adverse conditions. The works also included an aqueduct, some 6½ miles long, of which 2½ miles was constructed in tunnel, leading to the existing purification plant.

The construction of impounding reservoirs of large size in S.E. England is a novel development. The rainfall there is small, and for purposes of water supply, only the winter rainfall yields an appreciable run-off for storage. For this reason, much of the supply is drawn from wells. Hastings relied entirely on well water until recent years, most of the wells being driven into sandstone strata. It was however characteristic of these wells that the original yield dropped considerably after a period of time; for instance one well with an original capacity of about 2 m.g.d. now yields only about 0.45 m.g.d. Owing to this characteristic and the need for increased supply the Great Sanders reservoir, which has a capacity of 183 million gallons, was constructed and gave Hastings its first surface water supply. This work was followed by the building of the Darwell scheme which was begun in 1937.

Considerable opposition was made to the construction of the reservoir, and the scheme includes provision for a variable flow of compensation water, the minimum flow being less in the winter than in the summer. With existing supplies, the total water available to the Hastings district is now between 5 and 6 m.g.d. The maximum consumption last summer was about 3 m.g.d., but various rural areas will also be supplied by the new reservoir, and a number of of them will be receiving piped water for the first time. Various engineering difficulties were met in building the dam, and a large amount of pressure grouting was required in one section where the permeable Ashdown sandstone was met at a high level, where the Wadhurst clay had been expected. The catchment supplying the reservoir has an area of 2,382 acres. In the original scheme prepared in 1937, provision was made for the diversion of neighbouring streams to increase the catchment, but owing to the changed conditions since the war this part of the scheme has been modified and any additional supply that is required will pumped into the reservoir from an adjoining area. When filled, the reservoir covers an area of about 160 acres. It has been constructed by direct labour to the designs of S. Little M.I.C.E., formerly water engineer to the Borough of Hastings.

The Institution of Mechanical Engineers.

The presidential address of the Institution of Mechanical Engineers was delivered by Dr.S.F.Dorey at a general meeting of the Institution in London on Friday October 20th. Part of the address is reproduced below.

Marine Reduction-Gearing

A subject to which I have had to give much attention in recent years has been that of improvements in the design and constructional accuracy of marine reduction-gearing. This is a field holding equal interest for the mechanical engineer - an interest which, today, is enhanced by the vision of an internal-combustion turbine world, if not just around the corner, perhaps not so very far ahead.

Between the wars, after the early failures in double-reduction gears, the application of turbine gearing had been confined mainly to the single-reduction type for such vessels as fast cross-channel steamers and large passenger liners. There seems little doubt now that, in those early double-reduction gears, what was then generally attributed to faulty material should in reality have been debited largely to inaccurate gear-cutting, particularly in respect of surface finish. Here it is of interest to record that one of the first engineers to recognize the determining influence of gearing inaccuracies on permissible pressures was the Institution's Secretary, Sir Henry Guy, who stated nearly thirty years ago, in the discussion on two papers, that the most serious difficulty to be encountered with gearing arose from the inertia forces which resulted from errors in the gears. He also pointed out the urgent need for the development of gear-gauging methods before improvements in accuracy of production would be possible.

In 1939 a request was received to investigate a series of mysterious first-reduction pinion failures in single-helical, double-reduction Bauer-Wach geared drives representing more than 100,000 gross tons of shipping classed with Lloyd's Register. The solution of this problem turned out to be important not so much on its intrinsic merits, considerable though these were, but on account of the light it shed upon the nature of vibratory phenomena in turbine gearing generally, their sources of excitation and the equipment necessary to measure and detect them. Briefly, observation showed that the vibration present was of extremely high frequency, certainly in the audible range, and further, that the source of the vibration lay in gear-cutting inaccuracies which, with the aid of resonance, were capable of causing fatigue failures of pinion teeth and turbine blading (1). In order to be in a position to record and analyse these high-frequency torsional and axial movements of gears for the purpose of estimating the resulting additional dynamic tooth-loading, an M.I.T. (Massachusetts Institute of Technology) recording-oscillograph equipment, complete with calibrator, was obtained in 1943, together with a General Radio sound-level meter and wave analyser.

The Bauer-Wach investigation also revealed that equipment at that time for gauging errors in gear teeth was either non-existent or of a relatively crude nature. It was for this reason that I approached the Metrology Division of the National Physical Laboratory, where it was learned that the late Dr. Tomlinson had already been briefed by the Engineer-in-Chief's Department, Admiralty, to develop suitable equipment for gauging errors in gears and, in particular, for measuring the originating inaccuracies in the gear-hobbing machines. Dr. Tomlinson's excellent work, with the support of the Admiralty and ourselves, resulted in the production of a series of precision gauges which were acknowledged to be far in advance of anything similar at that time. In his ingenious undulation recorder alone, Dr. Tomlinson's contribution to our knowledge of gearing inaccuracies has been truly invaluable. Armed with these instruments, we quickly discovered that the standards of accuracy in Great Britain for hobbed mercantile-marine gears were often far from what they should be. In 1943 this work was considerably accelerated by reason of an approach made by Engineer-in-Chief and Director of Merchant Shipbuilding Departments, Admiralty, also Machine Tool Control, Ministry of Supply, who were anxious to draw up standards of accuracy for new gear-hobbing machines which were to be supplied to certain gear cutters throughout Great Britain, having particular regard to the need for ensuring the maximum attainable accuracy in the many double-reduction sets for the British 6,800 s.h.p., 15-knot cargo liner programme, then getting under way. It was here that the experience gained with the M.I.T. and N.P.L. equipment proved so valuable and enabled tentative standards of accuracy to be drafted. This important work was later transferred to the British Standards Institution with a view to widening the field of experience in drafting requirements, not only for gear-hobbing machines, but later also for turbine gearing generally, for which no British Standards Specification then existed. Concurrently, we were asked by Engineer-in-Chief's Department, Admiralty, to carry out, on board a number of H.M. ships, measurements of the vibratory movements of gear elements, combined with noise analysis. The measured frequencies enabled deductions to be made, with almost uncanny certainty, as to which particular periodic error in the gear-hobbing machine was responsible, and from the measured amplitudes it was in many cases possible to estimate the additional tooth-loading, which not uncommonly was of the same order as the mean transmission-loading.

The results of all this work were summarized in 1947 in a paper (2) before the North East Coast Institution of Engineers and Shipbuilders.

The principal conclusions to be drawn from our investigations are, I think, the following:-

(a) For as-hobbed gears of present-day materials, the removal of undulations, surface irregularities, and reduction of pitch errors is essential if specific tooth-loading is to be increased and, or alternatively, size of gearbox reduced. The same need would apply to the diminution of gear noise.

(b) Increased specific tooth-loading, by allowing a reduction in the diameter of gears, in turn enables still greater accuracy to be attained, the effect being cumulative.

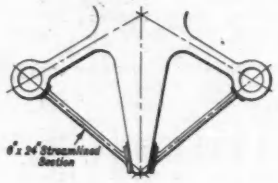
(c) A physical limit is set, either by present-day workshop methods or by metrology, beyond which it is not possible to improve the accuracy of the as-hobbed gear. For those cases where extreme tooth-loading and, or alternatively, pitch-line speeds are essential, such as may be needed for internal-combustion turbine drives, it will be necessary to apply post-hobbing finishing processes, such as shaving or grinding, in conjunction with harder materials. The accuracy of the final product will, however, still largely be governed by the degree of precision attained in the gear-hobbing machine.

There is reason to believe that the standard of accuracy of marine gear-cutting today has considerably improved as a result of these investigations, a factor which may very well have influenced owners and contributed to the present tendency to swing back towards the double-reduction gearded installation for powers above 6,000 s.h.p. per shaft.

Hull Vibration and Engine Balance

Of the various types of marine machinery it is usually only the steam reciprocating engine, with its relatively few cylinders of unequal size, which constitutes a potential exciter of undesireble hull vibration. Fortunately, in the most common class of cargo carrier of, say, 400-450 feet length and 10,000-12,000 tons deadweight capacity, the usual service revolutions, say, 65-75 r.p.m., are commonly just below the fundamental two-node vertical critical speed when loaded, and in the absence of resonance the lack of dynamic balance is not troublesome. Of recent years, however, there has been a tendency for revolutions to be increased with a view to improving the power/weight ratio and, as a result, the need for more accurate methods of predicting natural frequencies of ships' hulls has been accentuated. During the war years also, a considerable number of naval auxiliary vessels were fitted with relatively fast-running machinery of this type, and in some cases requests to carry out theoretical and practical investigations into

problems of engine balance and hull vibration were received. Here our mercantile-marine experience proved very valuable, and we were able to recommend considerable improvements. The desirability of maintaining steady navigating and gun platforms in this class of ship needs no emphasis. Propeller-excited hull vibration has also on occasion required our investigation and one particularly interesting war-time example comes to mind. A 25,000 ton, twin-screw geared-turbine-driven passenger ship suffered serious fatigue damage to the cast-steel propeller shaft brackets and bossing plating as a result of resonant vibration approximately in the vertical plane. The vibration was excited by the reaction forces at the shaft bearings arising from the successive passage of the propeller blades through the variable wake abaft the after edge of the shaft brackets, and was completely cured by fitting streamlined struts between bossings and keel, as shown in the accompanying drawing.



STRUTTING OF PROPELLER-SHAFT BRACKETS OF LARGE TWIN-SCREW PASSENGER VESSEL

Since the 1939-45 war our activities in this field have been merged to some extent with those of the British Shipbuilding Research Association, and, in order to accumulate accurate data on hull natural frequencies and the effects of unbalanced machinery, my research staff conceived the idea of building a centrifugal-type vibration exciter capable of generating vibrations in either vertical or horizontal planes. A design was prepared from our basis plans and in 1947 the exciter was constructed by W.H.Allen, Sons and Company, of Bedford. It has a speed range up to 200 r.p.m. and can generate a maximum alternating force of 15 tons. The apparatus consists of three adjustable out-of-balance weights, chain-driven through a gearbox by a 30 h.p. variable-speed D.C. motor supplied from a portable, self-contained, oil-engine-driven generator. The weights revolve about a fixed hollow shaft, the two outer weights having each one-half the mass of the central weight and being rotated in counter-rotation to it. By altering the phasing of the two outer weights relative to the inner, a force of variable magnitude can be applied in the vertical or horizontal plane.

The exciter, which weighs 11½ tons, when bolted to the poop or fo'c'sle deck of a vessel can then, by variation in the speed and direction of the force, be made to excite any of the principal modes of vibration chosen for investigation.

Readings of portable low-frequency recording vibrographs, taken at a number of stations along the strength deck from forward to aft, enable the vibration profile of the vessel to be plotted for any condition or loading, or other variable.

With this machine we have carried out a number of investigations on different types of ships for the British Shipbuilding Research Association, and these have included the accurate measurement by vibrograph of natural frequencies and vibration profiles (up to the four-noded mode in the case of one 10,000-ton cargo ship). I am confident that the information so derived will add considerably to our knowledge of the factors affecting the vibration of ships' hulls, and prove of great value both to naval architects and to marine engineers in the avoidance of this potential nuisance, from the aspect both of human comfort and of the fatigue life of ships' structures.

REFERENCES.

(1) 1942 DOREY, S.P., and FORSYTH, G.H. Trans. Inst. N.A., vol.84, p.207, "An Investigation of the Failure of a Single Helical Geared Turbine System due to Combined Axial and Torsional Vibration".

(2) 1947 DOREY, S.P., and FORSYTH, G.H. Trans. North East Coast Inst. Eng. and Shipbuilders, vol. 63, p.267, "Some Gear Cutting Inaccuracies & their Effect on Gear Loads & Gear Noises".

(To be continued)

N.E. Coast Institution of Engineers & Shipbuilders

At the opening general meeting of the sixty-seventh session of the North-East Coast Institution of Engineers and Shipbuilders on October 20th, Sir Philip B. Johnson gave his presidential address, in which present and future developments in engineering and shipbuilding were surveyed. Sir Philip felt that the chief development was co-ordinated research, and he emphasised the value of the work of both the British Shipbuilding Research Association and P.A.M.E.T.R.A.D.A., The effect of improvements in technique on productivity was mentioned and Sir Philip made a plea for wider objective study and greater flexibility of labour by the removal of rigid trade demarcations. Comment was made upon the education and appropriate training of staffs and several points were raised concerning the scope of technical training, suggesting a number of ways in which improvements might be effected. Regarding the standardisation of capital equipment, caution was advised, but Sir Philip said that a good deal could be done in this direction without spoiling Britain's "tailor made" products. In considering future developments, he noted the advance in welding, improvement in ship's lines, investigations into the use of light metals and the study of problems concerning corrosion and vibration.

Sir Philip mentioned the problems involved in improving the diesel engine, and in the use of high steam conditions for turbines; possible trends in the design of reduction gears; the difficulties to be overcome in developing the gas turbine; and he had something to say regarding the application of atomic energy to the propulsion of ships. The President finally reminded his audience that we could no longer rely for export on mineral resources but must depend upon the productivity of our labour force; our brains could not be nationalised, but could only flourish in an atmosphere of unrestricted enterprise.

New Signal Box at Agecroft Junction

A new signal box at Agecroft Junction, Pendleton, on the London Midland Region, contains a number of points of interest. The roof of the new box is supported on slender steel columns and the design has made possible the introduction of a continuous window which gives the smallest possible obstruction to the signalman's vision. The signal box is a block post in the Manchester-Bolton main line at the junction of the "connecting lines" which forms an alternative route to and from Manchester via Pendleton Broad Steeet Station. The working of the existing signals has been transferred to the new signal box which, however, will also control the inlet and outlet of a set of three new sidings which have been laid down to serve the new Agecroft B.E.A. power station.

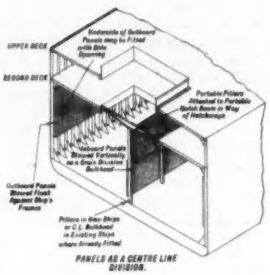
The new frame is positioned at the side of the signal box away from the running lines and has 65 levers. This frame is mounted directly on the operating floor, with separate counterbalance levers underneath, and the tappet interlocking is actuated by the catch handle. White plastic covers which have been fitted to the lever handles are intended to improve the signalman's grip, to avoid the present difficulty in keeping the handles clean and, at night, to show up any levers which are reversed and therefore partly obstruct the working space.

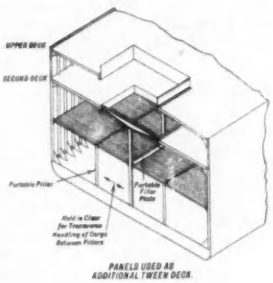
Plastic material has been used for an illuminated track diagram of a recently developed design. This diagram consists of a thin sheet of non-reflecting nylon-finish white plastic on which the track layout and symbols have been printed in black. It is stated that this new diagram has good non-reflecting properties and is much more distinctive than the diagrams previously used which had to be hand painted to get equivalent results. The diagram is easy to clean and cheaper and quicker to make, and, should the necessity arise, it can be readily altered in situ. Polyvinylchloride lamp covers have been used for the track lamps, in order to improve the angle at which these lamps can be observed.

Portable Deck Grain Division

The paucity of orders for tramp ships, arises from a number of causes and reflects not only the uncertainties of world commercial conditions but the changing pattern of Britain's export trade. At one time over 75,000,000 tons of coal formed a large proportion of our annual outward cargoes but the increasing competition of continental exporters and the gradual change-over to oil fuel for bunkers reduced the export figure to a little more than 40,000,000 tons per annum by 1939. Post war coal production is such that after satisfying internal demands only about 15,000,000 tons are available for shipment abroad and there appears little likelihood of this amount being increased.

These figures indicate that coal exports will never assume again their former preponderance in our outward cargoes and complimentary to this is the increase in the export of manufactured goods, taking the place of coal. This basic change emphasises the need for a modified design of cargo ship which can carry bulk or parcel outwards and bulk cargoes homewards.


UPPER DECK
SECOND DECK
Portable Pillars Attached to Portable Bolted Beam in Way of Hatchcoamings
Outboard Panels Stowed Vertically as a Grain Division Bulkhead
Outboard Panels Stowed Fixed Against Ship's Frames
Pillars in New Ships or C.L. Bulkhead in Existing Ships where Already Fitted
PANELS AS A CENTRE LINE DIVISION.



PANELS USED AS ADDITIONAL TWEEN DECK

Evolved over a long period of years the normal tramp steamer has a number of deep holds and possibly one tier of tween decks, a partial centre-line bulkhead and is fitted with wooden shifting boards. This design was admirably suited, from the point of view of efficiency and economy, for the carriage of parcels cargoes when coal is not available. To use deep holds, parcels must be stacked and this calls for strongly built and expensive wooden cases. If suitably cased cargo or coal is not available then the vessel must proceed in ballast and the cargo freight earned on the homeward voyage must cover the costs of the round trip.

The need for an additional tween deck appears to have been met by the introduction of the "Mezzo" deck grain division, a model of which we were able to inspect recently. This system is designed to perform the duties of shifting boards in a grain ship and to swing into position to form a temporary deck to take parcel cargoes. The accompanying line drawing illustrates that the system consists of panels, the sizes of which are governed by the dimensions and requirements of individual ships. The panels are hinged in fixed positions on the ship's side and at the centre line or are made fully portable. In the hinged down position the inboard panels form a middle line division, and the outboard panels, although lying inside the line of the frames, do not result in any marked lost of space. In the horizontal position the panels, supported by portable pillars, form an additional tween deck which allows the original hold space to be filled with uncased cargo, a valuable asset where motor vehicles are concerned.

The division can be built either in steel or aluminium alloy. With steel as the constructional medium the raising and lowering of the panels will require the assistance of tackles operated by wires led to the holds from the ship's winches, while the weight of panels built in aluminium alloy will be such that they can be handled manually. The development in aluminium alloy construction has been carried out by T.I.Aluminium, Ltd. and this company produced the model which was on view. Specially designed extruded sections riveted together make up the panels and reinforced corners take removable hinge pins. Hinges taking the outboard panels are mounted on the face of the frames and when not in use as a deck the panels are hinged up against the frames and secured by a drop catch.

A runway, lugged to the deck beams over, supports lifting blocks for handling and for dropping the panel panels to a lower hinge position should the depth of the hold be insufficient for direct hingeing up. Hinge plates attached to portable channel stanchions and the centre line bulkhead support the inboard panels. When the ship is carrying grain the panels are hinged up on one side and down on the other to form a centre line division. The portable stanchions which are bolted to the hatch webbs and to fittings on the tank top, can be fitted either in one length or split into two lengths and scarfed, the system adopted depending upon loading arrangements. Along the fore and aft joint line of the panels a number of portable pillars are placed which have heel fittings bolted to eye-plates on the tank top and a cruciform casting head to support the corners of four adjacent panels. The panels are held in place by lashings or rigging slips for which eye-plates have been provided.

Working from the ship's plans the division can be fabricated in advance ready for fitting into the vessel when next in dock and, once fitted, the grain deck will save the building and dismantling of craf cradles and the necessity of disposing of wooden dunnage. The first ship to be equiped will be the open shelter-deck vessel "Burmount" for which John I. Thornycroft and Co. Ltd. are preparing the drawings. The system has received approval in principle but it will be necessary to submit detail plans to the Ministry of Transport for each ship to be fitted. The "Mezzo" deck grain division is being developed by James Burness and Sons Ltd. (Technical Department), 19, Queens Terrace, Southampton.

THE LATE MR. W.H. PETERS O.B.E., M.I.E.E.

We regret to announce the death, recently, of Mr. W.H. Peters, assistant general manager of the Coventry group of factories of the General Electric Co. Ltd. Mr. Peters, who was 52, studied at Emanuel School and the Royal Military College, Sandhurst. He was destined for a military career and served with the rank of Captain during the first world war, but he received wounds which forced him to return to civilian life. In 1925, after taking an engineering degree at University College, London, he joined the research laboratories of the General Electric Co. Ltd., where his duties brought him into contact with the company's radio and telephone works. He was appointed chief engineer of the radio group at Coventry in 1930 and, nine years later, when the company's radio interests were transferred to the present radio and television works, he was appointed manager. Further promotion came in 1943 when he was appointed assistant general manager of the Coventry group of works and was in charge of its radio activities. His work during the second world war earned him the award of the O.B.E.

WORLD POWER CONFERENCE:- The second post-war sectional meeting of the World Power Conference is to be held at New Delhi, India, from January 10th to 15th 1951. The British delegation to the meeting will include Sir Vincent de Ferranti, who has recently succeeded Sir Harold Hartley as chairman of the International Executive Council and British National Committee of the World Power Conference. The International Commission on Large Dams will hold its fourth congress at New Delhi at the same time as this sectional meeting of the World Power Conference.

INTERNAL COMBUSTION TURBINE LECTURES:- The Institution of Mechanical Engineers announces that a third, and new, special series of six lectures will be given in the Lecture Theatre at Storey's Gate, Westminster, S.W.1. by the staff of the National Gas Turbine Establishment on Tuesday and Wednesday, November 21st and 22nd, at 11 a.m. each day. Tickets of admission can be obtained by application to the Secretary of the Institution.

Industrial and Labour Notes

ENGINEERING WAGE CLAIMS

Wage claims at present pending or under negotiation affect the engineering industry in which no settlement has been reached since the rejection of the demand for a general increase of £1 a week. More recently, the Engineering and Allied Employers' National Federation has offered to increase the weekly wages of lower-paid unskilled workers and to increase the pay of skilled men. But the Confederation of Shipbuilding and Engineering Unions has rejected that offer and has now reported the dispute to the Ministry of Labour.

Another claim in dispute is one advanced by the Federation of Building Trade Operatives that building craftsmen and attendant labourers employed by members of the Federation of Civil Engineering Contractors should receive the same rates and conditions as those governing corresponding work in the building industry. As negotiations between the parties have not so far been successful, the Minister of Labour has appointed a committee to inquire into and report on the claim. Sir John Forster, K.C., president of the Industrial Court, is chairman of the committee.

THE NATIONAL JOINT ADVISORY COUNCIL

The National Joint Advisory Council - which consists of representatives of the British Employers' Confederation, the Trades Union Congress and of the nationalised industries - held its quarterly meeting in London on Wednesday of last week, under the chairmanship of the Minister of Labour. A statement issued after the meeting indicated that one of the matters discussed was the subject of manpower and the re-armament programme, about which a preliminary report was presented to the Council.

It has been estimated that the armament programme at its peak - probably in 1952 and 1953 - will call for the employment of an additional 250,000 workers, and the Council gave some consideration to sources from which those extra workers might be drawn. It was thought, for instance, that some might be gained by the absorption of unemployed, some by greater employment of married women and elderly people - a matter which might require "a certain adjustment of normal industrial practice" - and some by further recruitment of foreign labour. But, the report pointed out, all those sources together were not likely to meet the full demand, and it was expected that it would be necessary, in consultation with the Supply Departments, to divert a certain amount of labour from civilian production to work on defence contracts making use, at the same time, of the expedients of upgrading semi-skilled labour and the re-expansion of training facilities for skilled work.

Another matter of some interest discussed by the Council was a proposal that the Ministry of Labour should collect from employers information about the remuneration of salaried workers, which would enable the compilation of an index showing movements in the rates of pay, and actual earnings, on the lines of the index already published in respect of manual wage-earners. It was decided, however, that the matter should be referred back to the Government statistical advisers for further consideration.

TRADE DISPUTES

The Ministry of Labour has reported that, during the month of September, 132 stoppages of work through industrial disputes were in progress. That number included sixteen stoppages which began before September and were continued in the early part of the month. The number of workpeople affected, directly and indirectly, by the 132 stoppages in September was 44,100 and the aggregate number of working days lost was 152,000.

Of the stoppages in progress during September, eighty-seven were in the coal mining industry, involving 17,100 workers and causing a loss of 39,000 working days. The first phase of the London printing dispute also affected the September figures. That phase actually began on August 30th when 3600 compositors in certain London printing offices were dismissed for breaking their agreement with the London Master Printers' Association. The Ministry of Labour estimates that in that phase of the dispute 28,000 working days were lost. An unofficial strike of 1610 London gas industry workers which began on September 16th and did not end until October 7th was another event which influenced the loss of working days in September.

BRITISH OVERSEAS TRADE

The Board of Trade has announced that exports of United Kingdom goods in the month of September were valued at £171,400,000, a figure which was about £3,000,000 below the average for the first eight months of this year. The total value of exports in the third quarter of 1950, however, was £542,900,000 - the highest quarterly figure to be recorded. It has been estimated provisionally that the volume of September exports was 152 per cent of the 1947 monthly average, compared with 169 per cent in August and 155 per cent in the first six months of this year.

The value of imports in September was £193,900,000, and of re-exports £9,100,000, so that the excess of imports over total exports was £13,400,000. It may be noted that September imports were below the figures for the preceeding four months. Raw material imports were generally lower than in August, particularly of iron ore, iron and steel scrap, tin ore concentrates and ores of precious metals. Imports of refined petroleum, however, were higher than in August, and were valued at £11,200,000. Other import groups which increased in September were flax and woodpulp.

ANGLO-AMERICAN COUNCIL ON PRODUCTIVITY

The third full session of the Anglo-American Council on Productivity has been held recently in London, and at its conclusion a statement was issued surveying the Council's discussions. The statement said that Great Britain now was in a healthier and more stable condition than when the Council started its work two years ago, and in that improvement productivity had played an important part. Whilst exact measurement was impracticable, no authority had put the figure of increase in productivity for the first half of this year, as compared with last, at less than 6 per cent, and some had estimated the the figure as high as 9 per cent.

The main feature of the Council's work, the statement continued, had been the despatch of teams from the United Kingdom to the U.S.A. to visit corresponding American industries and to see for themselves how the methods of work differed in the two countries. So far, thirty teams had visited America, and three were now in that country. At the time of the Council's meeting, reports had been published by thirteen productivity and two specialist teams. In addition, plans had been laid for nine more teams to leave in the near future. Furthermore, the Council was glad to report that arrangements were now proceeding for the reception by British industries of "follow-up" teams from the U.S.A., and it was hoped that the earliest of them would soon be visiting the United Kingdom on the invitation of the British steel founding and cotton industries.

The council's statement pointed out that the worth of the teams' reports depended directly on the degree to which they were implemented, and special attention had been given to that point. It was acknowledged that the first stage must be the dissemination of the report, which was mainly a job for the team and the industrial organisations concerned. The second stage was implementation, which must generally take place within the individual firm. Many of the recommendations in the reports were of a long-term nature and their results must take time to work out and mature. Nevertheless, the Council declared, there was no doubt that the keenness and hard work of those concerned with giving effect to the recommendations of the teams had played a really significant part in the improvement in industrial productivity in Britain.

CLASSIFIED ADVERTISEMENT SUPPLEMENT

The Engineer

28 ESSEX STREET, STRAND, LONDON, W.C.2.

NOVEMBER 3, 1950

This Supplement includes the following classes of advertisement:

PUBLIC NOTICES
SITUATIONS VACANT
SITUATIONS WANTED
MACHINERY FOR SALE
MACHINERY WANTED
AUCTIONS ETC.

It is divided into TWO PARTS -

PART I - Advertisements received up to 20th October.
PART II- Advertisements received up to 27th October.

PART 1

PUBLIC NOTICES

HIS MAJESTY'S COLONIAL SERVICE
KENYA

A vacancy exists for an ENGINEER (WATER SUPPLIES) in Mombasa, Kenya. The duties will comprise the operation and maintenance of Mombasa Water Supply and the planning and construction of extensions thereto.

Appointment will be on two years' probation for permanent and pensionable employment in a salary scale £655 to £1,320 per annum. The point of entry into the scale, determined by age and approved experience, is likely to be in the region of £900 for a suitable candidate. Local Government superannuation rights can be preserved. Income tax is at a low rate.

Free passages are provided for the officer and his wife, and for children up to the cost of one adult passage, on appointment and leave, which is granted on full salary at the rate of 4½ days per month of service. An officer provided with furnished quarters pays a rent of ten per cent of his salary. When quarters are not available an allowance is payable. On first appointment a married officer will not be allowed to take his wife and family to Kenya until he has secured accommodation for them.

Candidates should be between 35 and 45 years of age. They must be A.M.I.C.E., or possess a degree in engineering, and have had at least five years engineering experience, most of which should have been on water supplies.

For an application form write, giving age, qualifications and experience to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, S.W.1. Please mention this paper and quote reference No. 27329/27. E5234.

UNIVERSITY COLLEGE HOSPITAL
Gower Street, W.C.1.

Inaugural Lecture by Professor H.E.M.Barlow will be given on "Currents and Fields in Electrical Engineering" at 5.30 p.m. on 21st November. ADMISSION FREE, WITHOUT TICKET.

E.A.L. Gueterbock,
E5139. Secretary.

CITY OF SHEFFIELD
EDUCATION COMMITTEE

COLLEGE OF COMMERCE AND TECHNOLOGY

Principal: G. LAWTON, Ph.D., F.R.I.C., A.M.I.Chem.E.

DEPARTMENT OF ENGINEERING

Applications are invited from suitably qualified and experienced persons for the following appointments:-

(a) LECTURER in Electrical Engineering to teach this subject to Ordinary National Certificare standard and above and to advise on the equipment and layout of Electrical Engineering Laboratories.

(b) LECTURER in Mechanical Engineering to teach in National Certificate and Craft Courses.

Both positions offer considerable scope to men with initiative, as the Department is new and expanding rapidly. Salary in accordance with the Burnham Further Education Scale, with additions for approved training, qualifications and industrial experience.

Forms of application and further particulars may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope. Completed forms should be returned within two weeks of the appearance of this advertisement, stating the post for which application is being made.

STANLEY MOFFETT,
Director of Education.
Education Office,
SHEFFIELD, 1. E5211.

CROWN AGENTS FOR THE COLONIES

MATERIALS ASSISTANT required by the Government of Kenya for the Public Works Department for one tour of 4 years. Salary according to qualifications and experience in scale £550 to £690 a year. Free passages and liberal leave on full salary. Gratuity payable on satisfactory completion of engagement. Opportunities exist for promotion to contract or pensionable posts. Candidates, not over 40 years of age, should have Higher School Certificate, Higher National Certificate in Building or equivalent qualification and experience in Civil Engineering Works or in a laboratory. Ability to take charge of men an advantage. Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. quoting M/N/23296/3E on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E5192.

LONDON COUNTY COUNCIL

South East London Technical College, Lewisham Way, S.E.4. Required as soon as possible LECTURER qualified to take Part-time Day and Evening Higher National Certificate and C.G.L.I. classes in Utilisation of Electrical Energy and Installation work. Salary in accordance with the Burnham (London) scale Application form, obtainable from the Secretary of the College on receipt of stamped addressed foolscap envelope, returnable by 4th November. (1331) E5195

STATE ELECTRICITY COMMISSION OF VICTORIA
22 - 32, WILLIAM STREET,
MELBOURNE, VICTORIA, AUSTRALIA.

The Commission is inviting TENDERS for the supply, delivery and superintendence of erection of STEEL FORMS for concrete placing and CONCRETE BUCKETS in accordance with specification No. 50 - 51/121 and A.7 Contract Conditions. Full particulars are available at the office of the Agent General for Victoria in London. Tenders, endorsed, "Tender to Specification No. 50-51/121", together with a Preliminary Deposit of £25/-/-., are returnable at the Commission's Office, 22-32, William Street, Melbourne, Victoria, Australia by 11 a.m. on Wednesday 15th November 1950. The Commission does not bind itself to accept the lowest or any tender. E5202

CITY OF BATH

CITY & WATERWORKS ENGINEER'S DEPARTMENT

Applications are invited for the appointment of a PERMANENT GENERAL ENGINEERING ASSISTANT in the department of the City and Waterworks Engineer at a salary in accordance with Grades IV or V of the A.P.T. Division (£480 - £570) according to qualifications and experience.

Candidates should have passed the final examination of an appropriate recognised professional institution, and preference will be given to those having experience with a Waterworks Authority.

The selected candidate will be required to pass a medical examination and contribute to the superannuation fund.

Applications, stating age, qualifications and experience, and including the names of three persons to whom reference can be made, should reach the City and Waterworks Engineer, Waterworks Office, 8a, Terrace Walk, Bath, not later than the 18th November, 1950. Canvassing direct or indirect is prohibited, and a relationship to a member of the City Council or to a Chief Official should be disclosed.

JARED E. DIXON
Town Clerk.
Guildhall,
Bath. E5210.

SUDAN GOVERNMENT

The Sudan Ministry of Agriculture requires an ASSISTANT SOIL CONSERVATION OFFICER aged 23 to 40, for service in the Sudan. The duties consist mainly in connection with surveying and siting surface water storage reservoirs made by "Carryall" scrapers and filled from various sources. Well field improvement projects and seasonal river control works may also be involved. The work entails a great deal of trekking for eight months in the year, and requires a tough constitution. Candidates must be A.M.Inst.C.E. or possess equivalent qualifications. Practical experience in field survey and construction of small hydraulic works or soil conservation work is most desirable.

Appointment will be on a Long Term Contract up to a period of ten years on a salary scale £E 617 to £E 1150, with a special post-service gratuity varying between £E 1500 and £E 3,000 according to length of contract.

Cost of Living Allowance varying between £E 142 and £E 352 per annum according to the number of dependents is at present payable, and, subject to certain limitations, an Outfit Allowance of £E 60 is payable on appointment. There is at present NO INCOME TAX in the Sudan. Free passage on appointment. Full particulars and application form may be obtained on application to: Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.L. Please mark envelopes "Soil Conservation 4/196".

E5246.

CROWN AGENTS FOR THE COLONIES

SENIOR DRAUGHTSMAN (CIVIL ENGINEERING) required by the Nigerian Government Railway for one tour of 18 to 24 months with prospect of permanent and pensionable employment. Commencing salary, including expatriation pay according to age and experience in the salary scale £860 rising to £970 a year plus temporary allowance of from £66 to £72 a year. Outfit allowance up to £60. Free passages for officer and wife and assistance towards the cost of children's passages. Liberal leave on full salary. Candidates must have had at least five years experience in the drawing office of a Railway Civil Engineering Department (or Consulting Engineer or Contractors with practice in railway work). Knowledge of design and construction details of civil engineering structure and railway track work is required, including ability to take off quantities, prepare estimates and draft general specifications.

A vacancy also exists for a DRAUGHTSMAN (Temporary Staff), having the same qualifications, on contract for one tour of 18 to 24 months in the first instance with an appreciably higher salary and a gratuity. Apply at once by letter, stating age, full names in block letters and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. quoting M/N/17417/3A. on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration.

E5233.

STATE ELECTRICITY COMMISSION OF VICTORIA
22 - 23, WILLIAM STREET, MELBOURNE, VICTORIA, AUSTRALIA.

The Commission is inviting TENDERS for the supply and delivery of PLATE GIRDER BRIDGES in accordance with Specification No. 50-51/116 and A.7 Contract Conditions.

Full particulars are available at the office of the Agent General for Victoria in London.

Tenders, endorsed "Tender to Specification No. 50-51/116", are returnable at the Commission's Office, 22-32, William Street, Melbourne, Victoria, Australia by 11 a.m. on Wednesday, 22nd November 1950. No Preliminary Deposit is being requested in this instance.

The Commission does not bind itself to accept the lowest or any tender.

E5265.

NORTH THAMES GAS BOARD

A DRAUGHTSMAN is required at POPLAR GAS WORKS. Applicants should preferably have had some experience in the maintenance of gas plant and be conversant with the design of steel structures and layout of buildings.

The starting salary will be according to age, qualifications and experience but will be not less than £415 per annum. The appointment is of a permanent nature and pension arrangements will be discussed with short list candidates.

Applications stating age and giving full particulars should be sent to the Staff Controller, North Thames Gas Board, 30, Kensington Church Street, W.8., quoting reference number 9866.

E5228.

BRITISH STEEL FOUNDERS' ASSOCIATION

Research and Development Division

The Division intends shortly to make further STAFF APPOINTMENTS at SENIOR EXECUTIVE LEVEL and applications are invited from candidates who have specialised in steel foundry technology, particularly in the following branches:

FOUNDRY PRACTICE
PLANT ENGINEERING

Successful candidates, who should preferably be of graduate standard, will report personally to the Director of Research, and will be responsible for the efficient operation of one or more of the major sections of the organization.

Salaries will depend upon individual ability and experience and the posts are pensionable. Assistance will be given if so desired in finding living accommodation in the Sheffield area.

Applications, which will be treated as strictly confidential, should be addressed together with details of experience and qualifications, to:

The Director of Research,
British Steel Founders' Association,
20A, Collegiate Crescent,
SHEFFIELD, 10.

October 13th 1950. E5276.

STATE ELECTRICITY COMMISSION OF VICTORIA
22 - 32, WILLIAM STREET, MELBOURNE, VICTORIA, AUSTRALIA

The Commission is inviting TENDERS for the supply, delivery and superintendence of erection of seven (7) only semi-portable CEMENT SILOS in accordance with Specification No. 50/51/115 and A.7 Contract Conditions.

Full particulars are available at the office of the Agent General for Victoria in London.

Tenders, endorsed "Tender to Specification No. 50-51/115 together with a Preliminary Deposit of £20, are returnable at the Commission's Office, 22-32, William Street, Melbourne, Victoria, Australia by 11 a.m. on Wednesday, 8th November 1950.

The Commission does not bind itself to accept the lowest or any tender.

E5201.

FOR SALE BY TENDER

At Wrexham Trading Estate, Wrexham, N.Wales, the undermentioned plant:-

TWO BOILERHOUSES each containing:-

4. "BETA" Water Tube Boilers by John Thompson Water Tube Boilers Ltd., N.C.R. 50,000 lbs/hr each, at 250 P.S.I. and 650°F. Complete with Economisers; Superheaters; Mechanical Stokers; Coal and Ash Handling Plant; Feed Pumps; F.D. and I.D. Fans; Deaerator; Control Panel; Water treatment plant and ancilliaries.

TWO TURBO ALTERNATOR SETS.

1. 4000 Kw. condensing set by C.A. Parsons & Co.Ltd., 250 p.s.i. 650 F. installed in Power House.

1. 4000 Kw. Pass out set by C.A. Parsons & Co.Ltd., 250 p.s.i. 650 F. Pass out pressure 65 p.s.i.

A schedule of the plant and Form of Tender may be obtained from the Secretary, Wales & Monmouthshire Industrial Estates Ltd., Treforest Trading Estate, Pontypridd, Glamorgan.

The closing date for Tenders will be 10 a.m., 20th January, 1951, and the Company does not bind itself to accept the highest or any Tender. E5275.

ROYAL TECHNICAL COLLEGE, SALFORD.

Principal: P.F.R.Venables, Ph.D., B.Sc., F.R.I.C.

Applications are invited for the post of SENIOR ASSISTANT in the MECHANICAL ENGINEERING DEPARTMENT. Candidates should hold a good Degree in Engineering or its equivalent and should have had teaching and industrial experience The Department offers full-time and part-time courses for the external degree of London University and for the Higher National Certificate and preference will be given to candidates offering Theory of Machines and/or Mechanics of Fluids to final degree standard.

Salary will be in accordance with the Burnham Technical Scale for Senior Assistants (£700 x £25 - £800 plus allowances).

Forms of application, together with further particulars of the appointment may be obtained from the Principal, Royal Technical College, Salford, 5. to whom they should be returned as soon as possible

H. H. TOMSON,
E5209. Clerk to the Governors.

WOLVERHAMPTON & STAFFORDSHIRE
TECHNICAL COLLEGE

Principal: W.E.Fisher, O.B.E., D.Sc.

Appointment of ASSISTANTS to commence as soon as possible. Salaries Burnham Technical Scale. The posts are:-

SENIOR ASSISTANT IN CIVIL ENGINEERING. Duties include classes for B.Sc.Eng. University of London also development of Building Science studies. Applicants should have suitable technical qualifications (e.g.degree or Institution Membership) combined with recent experience in industry or research. Salary scale £700 x £25 to £800 with additions for recognised training, for degree, and for First Class Honours.

ASSISTANTS IN MECHANICAL AND ELECTRICAL ENGINEERING. Duties mainly relate to Ordinary and Higher National Certificates in Mechanical Engineering, and full-time Engineering Diploma and Degree classes (ability to teach some Civil Engineering subjects an advantage). Salary Burnham Scale, with additions to basic scale for degree and recognised training. Maximum of basic scale £555 per annum. Commencing salary determined by teaching and/or industrial experience.

Further particulars from the undersigned.

F. LONSDALE MILLS.
Clerk to the Joint Education Committee.

Education Offices,
North Street,
Wolverhampton. E5253.

LIVERPOOL EDUCATION COMMITTEE

CITY OF LIVERPOOL COLLEGE OF TECHNOLOGY

Byrom Street, Liverpool,3.

Principal: R.R.Butler, M.Sc., F.R.I.C., F.C.S.

Applications are invited for the appointment of:- SENIOR ASSISTANT IN THE DEPARTMENT OF CIVIL, MECHANICAL AND MARINE ENGINEERING. Candidates should possess good graduate qualifications or the equivalent, preferably A.M.I.C.E. or A.M.I.Mech.E. and industrial experience in the design and erection of structures and civil engineering works, or A.M.I. Mech.E. and industrial experience in either mechanical or marine engineering. In addition, the candidate should have teaching experience to the final or standard of the Higher National Certificate in Engineering.

The salary will be £700-25-£800 plus appropriate allowances for training and qualifications.

Application form and conditions of appointment, etc., may be obtained from H.S. MAGNAY, M.A., Director of Education, 14, Sir Thomas Street, Liverpool, 1. to whom applications should be returned not later than 11th November, 1950.

THOMAS ALKER
Town Clerk and Clerk to the
Local Education Authority.
E5252.

HIS MAJESTY'S COLONIAL SERVICE
BRITISH GUIANA

A vacancy exists for a SUPERVISING ENGINEER in the Public Works Department, British Guiana. Duties will include the operation of dredging equipment, the use of reinforced concrete and administration.

Appointment will be on contract for 3 years in the first instance, on a salary scale of £1,000 - £1,200, the point of entry being determined by the candidate's qualifications. A higher salary would be considered for an exceptional candidate.

Free partially furnished quarters are provided at the site. Five days leave are allowed for each month of service, and free passages will be provided for the officer, his wife and up to three children on appointment and on completion of contract.

Candidates should preferably be between 35 and 45 years of age. They must be A.M.I.C.E. or possess a Degree in engineering and have had good general engineering experience. For a form of application write, giving particulars of age, qualifications and experience to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, S.W.1. Please mention this paper and quote No. 27322/161.
E5232.

HIS MAJESTY'S COLONIAL SERVICE
KENYA

A vacancy has occurred for an ENGINEER (HYDROLOGY) in the Public Works Department, Kenya. The appointment will be on probation for pensionable and permanent employment at a point, according to qualifications and experience within the incremental salary scale £655 to £1,320 per annum.

The duties of the appointment include the investigation of surface and subsurface water resources, the drafting of proposals for improvement of water supplies and the direction of the work of Assistant Hydrologists and Computors. Candidates must hold an Honours Degree in a branch of applied science, e.g. Civil Engineering, Geology or Physical Geography and they must have had experience in applied hydrology.

Age limits: 35 to 45. Superannuation rights of Local Government candidates can be preserved.

For further particulars and a form of application, apply at once by letter giving brief details of age, qualifications and experience to the Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, S.W.1. Please mention this paper and quote reference number 27322/192. E5231.

CIVIL SERVICE COMMISSION
DUBLIN

Positions vacant - ENGINEERS (MECHANICAL), Grades I, II and III in the Office of Public Works, Dublin.

(a) ENGINEER (MECHANICAL), Grade I. Salary scales: Man: £965 to £1175; Woman: £800 to £1035. Maximum Age Limit: 48 years on the 1st October, 1950, with extensions in certain cases. Essential qualifications include such experience as would enable a candidate to take complete charge of a large engineering workshop as works manager.

(b) ENGINEER (MECHANICAL) Grade II (Workshop). Salary scales: Man: £800 to £965. Woman: £635 to £800. Maximum Age Limit: 45 years on the 1st October, 1950, with extensions in certain cases. Essential qualifications include satisfactory experience of modern engineering workshop practice including cost fixing and the planning and progressing of works orders.

(c) ENGINEER (MECHANICAL) Grade II. (Field) (2). Salary scales: Man: £800 to £965; Woman: £636 to £800. Maximum Age Limit: 45 years on the 1st October, 1950, with extensions in certain cases. Essential qualifications include such experience of large scale engineering plant as would enable a candidate to take charge in the field of mechanical plant employed on large scale arterial drainage.

(d) ENGINEER (MECHANICAL) Grade III (3). Salary scale: Man: £430 to £800. Woman: £430 to £635 (Higher initial salary in certain circumstances). Maximum Age Limit: 30 years on the 1st October, 1950, with extensions in certain cases. Essential qualifications include adequate practical experience of Mechanical Engineering.

A recognised University Degree in Engineering or an equivalent qualification is essential for all posts.

Further particulars obtainable from the Secretary, Civil Service Commission, 45, Upper O'Connell Street, Dublin. Latest time for accepting completed application forms for all posts: 5.0.p.m. on the 21st November, 1950. E5274.

BRITISH ELECTRICITY AUTHORITY

EASTERN DIVISION

Applications are invited for the following posts in the Generation Construction Department at Divisional Headquarters in NorthnLondon:

GRADE I DRAUGHTSMEN (STRUCTURAL)

Commencing salary range £518 - £636 per annum which includes London allowance.

Applicants should have had experience in the design of structural steel work and reinforced concrete structures.

Initial salaries will be in accordance with the previous experience and qualifications.

The salaries are in accordance with the scale at present operating, but will be subject to negotiation through the medium of the appropriate negotiating body.

The appointments will be Superannuable in accordance with the British Electricity Authority and Area Boards Superannuation Scheme.

Applications stating age, experience, and present position, and endorsed "Grade I Draughtsmen (Structural)" should be submitted to arrive not later than 11th November, 1950, to the Divisional Controller, British Electricity Authority, Eastern Division, Northmet House, Southgate, N.14.

W.N.C. CLINCH,
CONTROLLER.

Northmet House,
Southgate, N.14. E5251.

YEOVIL RURAL DISTRICT COUNCIL

WATERWORKS

SUTTON BINGHAM SCHEME: CONTRACT No.3

Experienced public works contractors who wish to be invited to TENDER for the construction near Yeovil, Somerset, of the Sutton Bingham Impounding Reservoir are asked to submit to Messrs. Herbert Lapworth Partners, 25, Victoria Street, Westminster, S S.W.1. by 30th November, 1950, details of large scale public works carried out by them within the last fifteen years.

The work consists of an earthen embankment about 1,000 feet long and 42 feet high with clay puddle trench and puddle wall, river diversion works and road diversion works, the chief of which will be about 900 feet long on an embankment of a maximum height of approximately 29 feet.

It is intended to invite tenders in February, 1951, with a view to commencing work in May, 1951.

C.M. BRAMWELL.
Clerk of the Council.

28, Kingston,
YEOVIL.
19th October, 1950. E5289.

WEST SUSSEX COUNTY COUNCIL

COUNTY ARCHITECT'S DEPARTMENT

Applications are invited for the appointment of an ASSISTANT HEATING & HOT WATER DESIGNER - DRAUGHTSMAN (Male) at a salary in accordance with Grade IV A.P.T. Division (£480 - £525 per annum) of the Consolidated National Scales.

Further particulars should be obtained immediately from the County Architect, County Hall, Chichester, to whom detailed applications must be submitted not later than the 7th November, 1950.

T. C. HAYWARD.
Clerk of the County Council.

County Hall,
Chichester,
12th October, 1950. E5222.

CROWN AGENTS FOR THE COLONIES

ENGINEERING DRAUGHTSMAN required by the Tanganyika Government for the Public Works Department, for one tour of 24 to 36 months in first instance. Salary according to experience in scale (Male) £690 to £840 a year (Female) £552 to £672 a year. Outfit allowance up to £45. Provident Fund. Free passages. Liberal leave on full salary. Candidates not over 35 years of age must have had five years drawing office experience in design and preparation of plans for Civil Engineering Works including Roads, Aerodromes, Water Supply and Sewerage, Structures, etc. Female candidates must be SINGLE. Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. quoting M/N/24517/3A on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications, and will communicate only with applicants lected for further consideration. E5235.

SITUATIONS OPEN

A DESIGNER is required in the London office of Messrs.Markham & Co. Ltd., to work in heavy and medium general engineering. Applicants should have had experience in the development and design of special machinery and be capable of carrying out investigaions in the pre-design stages for various classes of work particularly hydraulic machinery, testing and lifting gear, and the mechanical equipment of research plant. A working knowledge of electrical equipment for the driving and control of such machinery would be advantageous.

Two DRAUGHTSMEN are also required for the same office to prepare final drawings for the same classes of work. Applicants should have had works training and experience in Drawing Office development and design of heavy experimental or special purpose equipment. A knowledge of hydreaulic, pneumatic and/or electrical machinery and control gear would be an advantage. Applications, which will be treated in confidence, should be made in writing and should state position applied for, age, qualifications, experience and training with dates, stressing particularly subjects of which intimate knowledge is claimed, present position and salary expected, and should be addressed to The Chief Designer, MARKHAM & Co.Ltd., 8, The Sanctuary, London, S.W.1. E3582 A.

A few vacancies now occur at the English Electric Works at Rugby which should prove attractive to MECHANICAL DRAUGHTSMEN. Draughtsmen are required for Water Turbine design and detail and/or associated foundation and arrangement work. Men with high grade general mechanical experience are offered the opportunity to adapt themselves to this interesting class of work. Good salaries are paid to suitable men in addition to a generous pension and bonus scheme. Please write quoting ref. 146A to Central Personnel Services, English Electric Company Ltd., 24/30, Gillingham St., London, S.W.1. E5186 A.

A large company of light engineers requires a MANAGER to control all manufacturing activities in a self contained unit. Applicants must have adequate technical knowledge and understanding to comprehend design and manufacturing problems. Selection of applicants will be made on the basis of their proved ability to lead and control a team. The successful applicant, who should be 35 to 45 years of age and must have previous executive experience in a large company, will be paid a high salary commensurate with responsibility. Kindly state full particulars, including salary required. Address, E5189, The Engineer Office. A.

A large company in North West England expanding and reorganising Switchgear Department have situations vacant for first class DESIGNERS for development of air break and oil circuit breakers. Good salary and opportunities for men with initiative, experience and desire to take responsibilities. Write, giving full details mentioning ref. GGG. Address, E5255, The Engineer Office. A.

A large manufacturing organisation with factories throughout Britain require at their head office, London, a SENIOR PLANNING ENGINEER. Applicants should be 30/40 years of age and have a good university degree and/or corporate membership of the Institute of Mechanical or Chemical Engineers. Should have some practical works experience and have held responsible positions dealing with design, development, planning and installation of chemical plants. This post would necessitate some travelling throughout the country and offers excellent opportunities with an attractive salary. Apply giving full details of age, qualifications and experience to Dept. M.73, Box E.4250, A.K.Advg., 212a, Shaftesbury Avenue, W.C.2. E5280 A.

A MACHINE TOOL DESIGNER (CANADA); ELECTRICAL/MECHANICAL ENGINEER for TRAMWAYS (Overseas); CHIEF INSPECTOR Machine and Cutting Tools; HEAD WORKING LAUNDRY ENGINEER also CHIEF ENGINEER; SENIOR DESIGNER Plastic Machines; PROCESS LAYOUT CABLE ENGINEER; FOREMAN PAINT SPRAYER; CIVIL ENGINEERS Senior and Junior, Structural, Sewerage, Harbour, etc; MARINE ENGINEERS 1st Class M.o.T; DRAUGHTSMEN and TRACERS; TECHNICAL EMPLOYMENT AGENCY, 179, Clapham Road, S.W.9. (BRIxton 3487) E5220 A.

A major industrial Company has vacancies in this country and in India for three ENGINEERS. Applicants should be aged 22/30 and graduates in mechanical or chemical engineering, or hold equivalent qualifications. Should preferably have had one or two years' industrial experience. These posts offer good salaries and excellent opportunities for promotion. In each case the work would necessitate travelling throughout this country during training. Reply giving full details of age, qualifications and experience to Dept. M.75, Box No.E4241, A.K.Advg., 212a, Shaftesbury Avenue, W.C.2. E5278 A.

A SENIOR MOTION and TIME STUDY ENGINEER is required for a light Electrical Industry manufacturing radio valves and cathode ray tubes. Applicants must have Higher National Certificate or equivalent, and not less than seven years engineering industrial experience, with ability to control. Knowledge of office administration highly desirable. Existing staff aware of this vacancy. Five day week, and full welfare amenities. Apply, Personnel Superintendent, The Edison Swan Electric Co.Ltd., Cosmos Works, Brimsdown, Enfield. E5245 A.

AERODYNAMICISTS with an engineering degree and good mathematical background are required by the English Electric Co.Ltd., for their Aircraft Division at Warton Aerodrome near Blackpool. Previous experience is desirable but applications from suitably qualified engineers without practical experience who desire to enter the field of aerodynamics will be given full consideration. Write giving full details of age, qualifications and previous experience mentioning ref. 435C to Central Personnel Services, English Electric Co.Ltd., 24-30, Gillingham Street, London, S.W.1. E5208 A.

Air and oil filter manufacturers require a research ENGINEER with degree in Physics or some similar qualification and several years' experience. The works are in a good residential area in Wales, in which a house would be provided after six months' probationary period, part of which would be spent in the London area. Salary will depend on age and experience but this post will provide an excellent opportunity in a large Company where initiative will be adequately regarded. Applicants should give full details of their education, career and interests outside business. Address, E5264, The Engineer Office. A.

An exceptionally promising appointment in the Glasgow area is available to a man, preferably under forty-five, with sound knowledge and experience of general engineering, production control and works costs at the managerial level. A.I.C. or similar training will be a recommendation. A good salary will be paid to the right man. Replies will be treated in confidence and should be addressed to the Managing Director, Shaw-Petrie Ltd., Pipework Engineers, North Hillingdon, Glasgow, S.W.2. E3626 A.

An experienced WORKS MANAGER is required by the North British Locomotive Company, Glasgow. Previous Managerial experience is essential and preference will be given to a man with a Locomotive background. Age 35 to 45 but exceptions will be considered. Applications which will be treated in confidence should give full details of positions held and corresponding responsibilities and should be addressed to the Managing Director at 110, Flemington Street, Glasgow, N. E3576 A.

Applications are invited by the Marconi's Wireless Telegraph Co.Ltd. for the post of PROJECT ENGINEER in the Broadcasting Division. Applicants should have a University Degree in Electrical Engineering or equivalent qualifications and have had experience in the installation, operation and maintenance or design of transmitting or studio equipment. The successful candidate must be able to assist in the planning, organisation, co-ordination and control of the development, sales, production, distribution and installation of all television equipment handled by the Company. Write giving full details mentioning ref. 466 to Central Personnel Services, English Electric Co. Ltd., 24-30, Gillingham Street, London, S.W.1. E5293 A.

Applications are invited for the position as SECTIONAL ENGINEER at a large Copper Mine in Northern Rhodesia. It is considered that a man originally qualified as a Mechanical Engineer is likely to possess the best grounding for successfully adapting himself to the requirements of the position. The duties, however, cover a very wide field and only men who have, since qualifying, acquired a thorough knowledge of engineering in all its branches and have had experience in plant erection and maintenance, together with the handling of large labour forces are likely to be suitable. The successful applicant would be directly responsible to the Resident Engineer, but would be required to act in many cases on his own responsibility and must possess initiative. The post is likely to be progressive for any man who can prove his ability and applicants should be between 35 and 45 years of age, holding a B.Sc. in Mechanical Engineering or who possess equivalent technical and professional qualifications. Commencing salary from £900 p.a. depending upon experience and qualifications, plus cost of living (at present approximately £200 p.a.) and bonus (at present approximately 47½% of basic salary). There is also a pension and life assurance scheme. Leave at 45 days per annum may be accumulated over a maximum period of three years' service. Write to Mufulira Copper Mines Ltd., Selection Trust Buildings, Mason's Avenue, Coleman Street, London, E.C.2., for application form. E5294 A.

Applications are invited for the position of MACHINE TOOL PLANNING ENGINEER in large Engineering Establishment situated in Belfast, Northern Ireland. A thorough knowledge of modern machine tools and the associated manufacturing processes is essential also a sound experience of design and special purpose machines. Attractive conditions offered to suitable applicant who will be directly responsible to Senior Executive for investigating and advising on all aspects of Machine Tools and efficient utilisation. Applications which will be treated in strict confidence should give full details of age, qualifications and experience, etc. Address E3627, The Engineer Office. A.

Applications are invited from ENGINEERS with experience of the erection of heavy electrical equipment, for supervisory positions overseas. In the first instance periods of service are likely to be of three years' duration. Attractive terms and conditions of employment which will be fully explained at interview. Apply quoting ref. 811 to Central Personnel Services, The English Electric Co.Ltd, 24-30, Gillingham Street, London, S.W.1. E5206 A.

Applications are invited from men between 32 and 40 years of age for the post of ASSISTANT POWER PLANT SUPERINTENDENT at Roan Antelope Copper Mines, Luanshya, Northern Rhodesia. The plant has an electrical generating capacity of 30 megowatts and has some 50,000 to 60,000 c.f.m.capacity in electric and turbo driven compressors. Turbo blowers of 45,000 c.f.m.capacity are also installed. Applicants must hold the Higher National Certificate and have had power plant or equivalent maintenance and operating experience. They should be familiar with water tube boilers, preferably pulverised coal-fired; the operation and maintenance of turbo-alternators; turbo and electric compressors; electric and steam driven feed pumps; circulating water pumps, and other auxiliary equipment etc. They must be able to direct operating personnel and be capable of critically examining control sheets and statistics relating to the performance of the plant. Commencing salary from £775 p.a. depending on experience and qualifications, plus cost of living allowance, (at present approximately £200 p.a.) and bonus (at present approximately 45% of basic salary). There is also a pension and life assurance scheme. Write: Roan Antelope Copper Mines Limited., Selection Trust Buildings, Mason's Avenue, London, E.C.2. for official application form. E5184 A.

ASSISTANT ENGINEER for Pakistan for erection, maintenance oilfield and refinery plant - good practical and technical training to Higher National Certificate Grade essential. Three years' agreement with Provident Fund with option of renewal if service satisfactory. Six months' home leave after 4½ years on full pay free passage free partially furnished accomodation free medical attention. Write stating age, experience, copies testimonials. Applicants must pass medical examination. Box H.919, c/o Streets, 110, Old Broad Street, E.C.2. E5224 A.

ASSISTANT to CHIEF METALLURGIST required for large General Engineering Works in East Midlands. Applicants should have wide experience of chemical and metallurgical work involved in general engineering practice, including Steel, Cast Iron, Non Ferrous materials, Fuels, Heat Treatment, etc. Applications stating age, full details of experience, qualifications and salary required. Address, E5262, The Engineer Office. A.

At the head office of the British Oxygen Co.Ltd., exist vacancies for one SENIOR and two JUNIOR MECHANICAL ENGINEERING DRAUGHTSMEN. Applicants should have had experience of plant lay-out and pipe work. The work will involve site visits. A mimimum of Ordinary National Certificate is desirable. These vacancies offer good salaries and excellent opportunities. Apply giving full details of qualifications and experience to Dept. M.79, Bridgewater House, Cleverland Row, St. James's, S.W.1. E5279 A.

At the head office of the British Oxygen Co.Ltd., exist two vacancies for JUNIOR MECHANICAL ENGINEERING DRAUGHTSMEN. Applicants should have had experience of Plant Layout and Pipe work. The work will involve site visits. Canteen facilities. Minimum of Ordinary National Certificate desirable. Apply giving full details of age, qualifications and experience to Dept. M.79, Bridgewater House, Cleveland Row, St.James's. S.W.1. E5221 A.

Aveling-Barford Ltd., invite applications for SENIOR DRAUGHTSMEN at their Grantham Works, with experience in design of heavy tipping vehicles and earth moving machines. Knowledge of modern transmissions would be an advantage. Applications to be made to the Personnel Manager, Aveling-Barford Ltd., Grantham or Newcastle. E5[illegible]

Cast Concrete Products firm require DRAUGHTSMAN. Central London area, to work under Products Development Engineer. Write giving age, experience and salary required, Box 109, c/o Walter Judd Ltd., 47, Gresham Street, London, E.C.2. E5225 A.

CHIEF INSPECTOR required by large radio manufacturer in the South of England. Applicants who must be prepared to undertake responsibility for inspection and test of radio and television produced on a large quantity production basis, must have adequate

theoretical understanding and have experience of controlling a large male and female staff of all grades. State full particulars including age and salary required. Address, E5191, The Engineer Office. A.

CHIEF PRODUCTION EXECUTIVE required by Manufacturing Precision Engineers in Greater London Area. Appointment involves complete responsibility for thorough reorganisation of all productive activities with a view to rapid and considerable increase in production to meet existing order book, and carries prospect of early General Managership. Substantial remuneration will be paid in line with the responsibility involved and the qualifications required. Engineering experience necessary but personality, organising ability and drive essential. Full particulars in confidence, including present remuneration and photograph if possible. Address, E3601, The Engineer Office. A.

CHIEF TEST ENGINEER required about 30 years of age to take charge of Test Laboratory and project section in connection with aircraft heat transfer equipment. Applicant must have sound engineering background preferably in aircraft engine field. Please apply in writing stating qualifications, experience, age and salary to Delaney Gallay Ltd., Vulcan Works, Edgeware Road, Cricklewood, N.W.2. E3606 A.

CIVIL ENGINEERS required by large Middle East Oil Company. Qualifications - Degree and/or A.M.I.C.E.; practical experience (varying in relation to stated ages and desirably including service in undeveloped overseas area) on substantial works - reinforced concrete/steel structures, road services. (a) DIVISIONAL £1100 desirable age limit 40. (b) AREA £850 desirable age limit 34. Salaries incremental from quoted entry levels, generous supplementary allowances, free furnished quarters/messing (or allowances in lieu). Biennial (paid) home leave. Pensionable posts. Married applicants should be prepared for initial two to three years' separation. Write quoting No. 32 to Box 3718, c/o Charles Barker & Sons Ltd., 31, Budge Row, London, E.C.4. E5200 A.

Cleveland Bridge & Engineering Co.Ltd. Darlington, invite applications from STRUCTURAL DESIGNERS and DETAILERS for posts in Drawing Office. Work of varied and interesting nature, including Bridge and Deep Foundation design and detail, also design of Rigid Frame Structures. Permanent pensionable positions. Write giving full particulars to the Managing Director. E3621 A.

Consulting Engineers require both SENIOR and OTHER ASSISTANT ENGINEERS. Applicants for senior posts must have experience of sewerage and/or sewage disposal. Pensions scheme. Salaries according to experience and qualifications. Apply in writing with full details to J.D. & D.M. Watson, 18, Queen Anne's Gate, Westminster, S.W.1. E5244 A.

CONTRACTORS' AGENTS and ASSISTANT ENGINEERS required by London firm of Civil Engineering Contractors for construction of new Electric Power Stations in London District as well as in the Far East. Apply in writing with full particulars of experience and salary required. Address, E3581, The Engineer Office. A.

DESIGN and LABORATORY ASSISTANTS required by large Engineering Firm in South-East London area for development of light electrical and mechanical engineering equipment, with prospect of advancement later to technical or sales staff abroad. Previous experience in design not necessary, but applicants must be of degree standard and have had some experience in an Engineering Works. Address, E5239, The Engineer Office. A.

DESIGNER DRAUGHTSMAN Senior and Junior required for Light Engineering Works; 5 day week, good prospects. Give fullest particulars of education, experience and salary required. Address, E3578, The Engineer Office. A.

DESIGNER required in S.E. London area with experience small and medium size A.C. and D.C. machines. Experience control gear an advantage. Applicants must be of degree standard. Address, E5240, The Engineer Office. A.

DRAUGHTSMAN. Chance Brothers, glass and Lighthouse works, Smethwick, invite applications from first class draughtsmen for the maintenance and constructional drawing office. A sound training and H.N.C. are essential qualifications. E5285 A.

DRAUGHTSMAN. Designer wanted possessing knowledge up to standard of Higher National Certificate in Mechanical Engineering with endorsement in Hydraulics if possible. A knowledge of Water Treatment Plant construction and design will be an advantage. A young man would be suitable with general engineering experience capable of working with the minimum of supervision. The job offers good prospects to the right man. An initial salary in accordance with age and qualifications will be paid. Details should be sent to William Boby & Co.Ltd., Water Treatment Engineers, Rickmansworth, Herts. E3602 A.

DRAUGHTSMAN, qualified general engineering, required by important firm in Leeds area. Pension scheme. Experience of oil handling plant and/or knowledge of general building requirements an asset. Age 25/30. Sent particulars of experience and salary required in confidence. Address, E3620, The Engineer Office. A.

DRAUGHTSMAN required with experience of machine design and /or plant installation. Applicants should be of British birth, under 35, have had 2 or 3 years workshop experience and possess at least the O.N.C. (Mechanical). Write for application form to E.P.Michelin Tyre Co. Ltd., Stoke-on-Trent. E3585 A.

DRAUGHTSMAN required for Plant and Vessel design and detail work; knowledge of structural and mechanical engineering an advantage. Modern factory conditions with 5 day week. Position offers advancement in progressive and expanding department. Assistance given in obtaining suitable accommodation locally. Applications in writing, with full details of experience and salary required to Personnel Manager, Newman Industries Ltd. Yate, Bristol. E5187 A.

DRAUGHTSMEN required. Age 25-30. Chemical Plants. Refrigeration experience useful. West End office. 5 day week: Pension scheme. Box 4224E, A.K.Advg., 212a, Shaftesbury Avenue, W.C.2. E5260 A.

DRAUGHTSMEN - Grand scope offered to men interested in producing intricate neat solid line arrangement drawings of Power Station Boiler Plant. Full A.E.S.D. rates. Victoria. Address, E5258, The Engineer Office. A.

DRAUGHTSMEN required with experience of general plant services and engineering. Write giving details of previous experience to The Personnel Officer, The de Havilland Engine Co. Ltd., Stag Lane, Edgware, Middx. E5292 A.

DRAUGHTSMAN required with experience in design and detail for crane drawing office, J.H. Carruthers, South Glasgow. Apply stating experience and wages required. E3629 A.

DRAUGHTSMAN with experience in the design of wood refuse exhausting systems and with a knowledge of sheet metal work required by a large manufacturing company in the N.17 area. 39 hour, 5 day week. Pension scheme in operation. Salary in the region of £500 to £550 p.a. Write with full details of qualifications and experience. Address, E3580, The Engineer Office. A.

ENGINEER-BUYER required by a progressive and rapidly growing Company associated with the chemical industry. The responsibilities of the position cover the purchase of plant and equipment and involve considerable contact with suppliers in various parts of the country. The position will be of interest to an engineer between 25 and 30 years of age who has leanings towards the commercial side of engineering. Applicants should have had works experience and possess a good degree. Careful training will be given and a good commencing salary will be paid. This is a progressive position in a Company which has sound personnel policies and good working conditions. Please include with initial reply an outline of career to date. Address, E5281, The Engineer Office. A.

Earth Moving Equipment. A vacancy exists on the staff of Blaw Knox Ltd, for a SALES ENGINEER with appropriate qualifications and field experience. The appointment is progressive, offering wide scope to energetic and experienced man to develop sales of a complete range of tractor mounted and tractor drawn equipment, together with Motorised Scrapers and Motor Graders. The successful applicant will participate in Company's Staff Pension Scheme. Reply, giving age, full particulars of experience, salary required to Blaw Knox Ltd., Clifton House, Euston Road, N.W.1. E5270 A.

Electro-Plating department of North London Engineering Firm require WORKING FOREMAN. Write in full detail. Address, E3619, The Engineer Office. A.

ENGINEER required to fill the position of Works Manager at a Bottling Factory situated in the North of England and producing a proprietory carbonated food beverage of national repute. Applicant must have an Engineering Degree or Higher National Certificate with good general training and experience in all aspects of factory management, including motion and time study. The Company is progressive and expanding and offers excellent scope and opportunity to the right man. The post is pensionable and there is in operation a Staff Participation Scheme. A four figure salary is envisaged. Write in confidence, giving fullest details of education, training, experience and age. Address, E 5237, The Engineer Office. A.

ENGINEER required for industrial organisation in Edinburgh to take charge of new department to estimate allowed times for non-repetitive work associated with factory maintenance; applicants should preferably have had estimating or rate-fixing experience, must have served a recognised engineering apprenticeship and have technical qualifications up to Lower National Certificate standard; salary £500 to £600 per annum depending upon experience. Write stating age and experience to No. 512, Keith & Co., Advertising Agents, Edinburgh. E343 A.

ENGINEER required to promote the sale of Precision Engineering products. Some technical qualifications are essential, and a knowledge of modern light oil hydraulic equipment advantageous. Some experience in the conduct of high level negotiations desirable. Write stating full particulars including age and salary required. Address, E5198, The Engineer Office. A.

Engineering Company in Central London require DRAUGHTSMAN having comprehensive experience in Mechanical Design. Locomotive experience preferred but not essential. Address, E3600, The Engineer Office. A.

ENGINEERING DRAUGHTSMAN required immediately for Specialist road plant development work. 4-6 months engagement initially. Salary in accordance. All expenses. Address, E3630, The Engineer Office. A.

ENGINEERING GRADUATE, single, with University Degree, required by Mufulira Copper Mines Ltd., Northern Rhodesia. No previous experience necessary. Excellent opportunity for training, mainly in Mechanical Engineering, and for this purpose Graduate would be expected to work for approximately three years in junior capacities, such as Junior Draughtsman, Research Assistant, Power Plant Operator etc., to gain practical experience. Starting £504 per annum, plus cost-of-living allowance of approximately £180 per annum, plus pension and bonus privileges. Official application form from Mufulira Copper Mines Limited, Selection Trust Building, Mason's Avenue, London, E.C.2. E5263 A.

ENGINEERS required to train as Estimators for non-repetitive work associated with plant maintenance in an Industrial Organisation in Edinburgh. Applicants must have served recognised Engineering Apprenticeship and have technical qualification up to Lower National Certificate standard. Salary £7.10.0. to £8.10.0. per week according to experience. Write giving full details to Box No. 571, Keith & Co., Advertising Agents, Edinburgh. E341 A.

EXPERIENCED PLANNING and PROGRESS MAN required by old established firm in S.E.Midlands 1,000 hands. Must have sound practical knowledge of modern machining and be familiar with visual planning methods and stock control. Address, E3573, The Engineer Office. A.

EXPERIENCED PLANNING and PROGRESS MAN required by old established firm in S.E. Midlands 1,000 hands. Must have sound practical knowledge of modern machining and be familiar with visual planning methods and stock control. Address, E3574, The Engineer Office. A.

FOUNDRY FOREMAN with experience of cupola and moulding wanted for small Foundry, Iron and Brass. Apply stating age, wage and previous experience to Cochran & Co., Annan, Ltd., Annan, Dumfriesshire. E5246 A.

JIG and TOOL ENGINEER wanted by Mechanical handling company to start department. Splendid chance for keen man. Write stating experience and salary. Address, E3572, The Engineer Office. A.

Leading shipbuilders of craft up to 250 ft. overall have vacancies as under due to a substantial increase in their volume of work.
1. ASSISTANT GENERAL MANAGER who must be fully experienced and qualified.
2. CHIEF DESIGNER with requisite essential qualifications, preferably experienced in construction of trawlers, tugs, barges, etc. Experience in aluminium construction will be considered an additional advantage.
3. QUALIFIED MARINE ENGINEER experienced in practical shipyard installation work of both high speed and ordinary commercial craft.
Adequate salaries will be paid in respect of each of the above positions which will give ample opportunity for further advancement. These positions also carry participation rights in the Company's Superannuation Scheme after twelve months satisfactory service. Applicants must give full details of their past experience, present position, qualifications, age, when free to accept work and present rate of enumeration. All applications will be treated in strict confidence. Address, E5229, The Engineer Office. A.

LOCOMOTIVE ENGINEER required by Consulting Engineers to supervise inspection and erection of locomotives to be built in Glasgow. Applicants should have served a recognised apprenticeship with a firm of locomotive builders or in a British Railway locomotive works and subsequently employed for not less than five years on locomotive construction or maintenance in a supervisory capacity. Experience in inspection or progress department would be an added recommendation. Technical education to H.N.C.standard. Age 35 to 45 years. Apply stating salary required and experience to Box 111, c/o Dawson, 129, Cannon Street, E.C.4. E5259 A.

London Contractors have vacancy for qualified SENIOR ENGINEER age 30/45. Exp. in organisation and labour control in connection with erection pipework, plant for gas and oil industries, power stations etc. Exc. opportunity keen man. Full particulars. Address, E5295, The Engineer Office. A.

MECHANICAL DRAUGHTSMAN with good general experience required for London Chemical and Metallurgical Design Office. Materials handling and structural knowledge preferred but not essential. Salary according to qualifications. Congenial conditions. Pensions Scheme. Write full particulars experience. Address, E3608, The Engineer Office. A.

MILLER - Universal Miller Chargehand reqd. Must be fully skilled and have initiative to take charge of section night shift. Small batch precision runs. New expanding factory. Canteen. Social Club. Please write stating age, experience, rate recd. and reqd. Address, E3622, The Engineer Office. A.

Old established firm in Home Counties has vacancy for METHODS ENGINEER. Production Medium/Heavy I.C.Engine Components. Batch production. Experience planning and ratefixing for machining essential. Knowledge time-study desirable. Excellent working conditions. Pension scheme. Staff permanency for suitable applicant. Address, E5261, The Engineer Office. A.

Peter Brotherhood Ltd., Peterborough, require DRAUGHTSMEN (Senior and Junior) preferably with experience in design of compressors, turbines and steam engines. Permanent positions, five day week, staff pension scheme. Write giving full details age, experience and salary required. E342 A.

Pilkington Brothers Ltd., Glass Manufacturers, have openings for well qualified CHEMISTS, PHYSICISTS and ENGINEERS, aged 23/30. The firm and its subsidiary companies operate large scale Continuous Processes, the control and development of which demand a high standard of technical knowledge. The company is looking for men with good University Degrees or other adequate qualifications to train for posts which combine technical and managerial responsibility, or for technical development work on the processes and allied plant. Good opportunities for promotion exist. Successful candidates will, in the first instance, be offered a three years' Agreement as Technical Assistants. Applicants should send outline of their education, research, industrial or Services experience, and age, to Chief Personnel Officer, Pilkington Brothers Ltd., St. Helens, Lancashire. E3624 A.

Press work and sheet metal operations. Frigidaire require a first class PRODUCTION MAN with experience in operating a large modern mass production press and sheet metal department using new tooling techniques. Technical training and administrative experience essential. This is a progressive position carrying good pay and prospects for the selected applicant. Applications stating age and full details may be sent in confidence to the

Director and General Manager, Frigidaire Division of General Motors Ltd., 401, Edgeware Road, The Hyde, London, N.W.9. Mark envelope "Press Shop Manager". E5227 A.

PRODUCTION CONTROLLER required by large light engineering company in London area. Applicants must have experience of production control, stores and progress in factory engaged on large quantity production and must be capable of undertaking the control of staff. A permanent and progressive position is available to man between 30 and 40 years of age who possesses the above experience with initiative and drive. Applications stating full details should be made to Box. No. E5190, The Engineer Office. A.

PRODUCTION ENGINEER required to undertake technical control of a precision engineering project by large company in London area. Essential qualifications are knowledge and experience of jig and fixture design for precision light engineering, understanding of the basic principles of time study and estimating. Applicants who will have first class opportunities of advancement should be between 35 and 45 years of age. Full particulars including age and salary required should be forwarded to Box No.E5188, The Engineer Office. A.

PRODUCTION ENGINEER, capable of introducing and developing new department to modernise existing system, plant and methods, required by large engineering concern in Yorkshire. Engineers, not younger than 35, with apprenticeship in Light Engineering or Machine Tool Manufacture, and with experience in Planning, Ratefixing and Jig and Tool Design for Semi-mass and Batch Flow Production of I.C. Engines or similar components, will be considered. Pension scheme available and a good salary will be paid to the right man, who will be given wide scope, offering excellent prospects. Only Engineers with genuine flair for this kind of work and with required experience need apply, giving, in confidence, full particulars of experience and salary requirements. Address, E5126, The Engineer Office. A.

Production vacancy. Large Paint Manufacturers situated in London require a MANAGER for their Container Manufacture Department. Experience of tin can and keg and drum manufacture as well as a general engineering knowledge is essential. Previous management experience or training called for. Apply giving age and experience. Address, E5185, The Engineer Office. A.

PUMPS - ASSISTANT CHIEF DESIGNER and ESTIMATOR with experience reciprocating and centrifugals required - West Scottish firm. Assistance for house purchase will be given. Salary according to experience. Address, E5238, The Engineer Office. A.

Qualified METALLURGIST (Non Ferrous) required by manufacturers in North London. Write giving full details of qualifications, experience and salary required. Address, E3618, The Engineer Office. A.

RAILWAY DRAUGHTSMEN required for design of Roller Bearing Axlebox Equipment for Locomotives and Rolling Stock. Please apply by letter to British Timken Ltd., Cheston Road, Aston, Birmingham, 7. E3575 A.

RATEFIXER. Man required aged 25/40 large manufacturing company (near city centre) Birmingham. Must be able to fix rates from drawings. Good prospects. Excellent conditions including staff pension fund. Apply giving full details experience, age and salary required. Address, E3604, The Engineer Office. A.

RATEFIXER required by large Engineering Firm in the Midlands for their machine shop, concerned with batch production of diesel engine components Applicants must be thoroughly experienced in modern machining methods and tooling technique and have a wide knowledge of Process Engineering. The appointment will be on a staff basis and ideal conditions pertain. Please apply giving details of age, experience and salary required to: The Central Labour Department, The Brush Electrical Engineering Co.Ltd., Loughborough, Leicestershire. E5215 A.

Required: SENIOR ESTIMATOR. Man with experience in general machine shop - sub assembly and final assembly on electrical and mechanical products, embracing radio, television and line telecommunication apparatus - able to pre-plan operations on above work as a preliminary to estimating. Applicants should state full particulars of experience with age and salary required. Address, E5196, The Engineer Office. A.

Richard Costain Ltd., require the services of a DESIGNER DRAUGHTSMAN, to work in their London office. Preference given to man who has had previous experience in the design and detailing of temporary work, with Civil Engineering Contractors. Apply in writing giving full details of age, experience and salary required to the Personnel Director, Richard Costain Ltd., Dolphin Square, London, S.W.1. E3625 A.

Richard Costain Ltd., require a FOREMAN PLATELAYER to instal and maintain contractors railways in work yards of their contract for the Apapa Wharf at Lagos Nigeria. Permanent railway works will follow at a later date for suitable man. Apply in writing only giving full details of age, experience and qualifications to Personnel Director, Richard Costain Ltd., Dolphin Square, London, S.W.1. E3605 A.

SALES REPRESENTATIVE required by progressive firm of London Structural Engineers and Contractors on salary and commission basis. Established contacts necessary in London; also Provinces an advantage. Good scope for live man. State full details and suggested terms. Address, E3633, The Engineer Office. A.

SENIOR DESIGN DRAUGHTSMEN. Experience of Engine Silencer and Air Filter design desirable, but not essential Please apply by letter stating age, previous experience and salary required to Secretary, Burgess Products Co.Ltd., Hinckley, Leics. E3639 A.

SENIOR DESIGNER DRAUGHTSMAN required for work in connection with Small Motor Cycle and Industrial Petrol Engines. Excellent prospects of advancement and scope for the right type of applicant. Write stating age, experience and salary required to: The Villiers Engineering Co.Ltd., Marston Road, Wolverhampton. E5254 A.

SENIOR DRAUGHTSMAN required for interesting work at large Chemical Works. Permanent position. Staff superannuation Scheme. Write giving full details and salary required to: Personnel Manager, F.W.Berk & Co.Ltd., Abbey Mills Chemical Works, Canning Road, Stratford, E.15. E3631 A.

SENIOR ELECTRICAL ENGINEER required for duty in Middle East areas of large Oil Company. Honours degree and/or A.M.I.E.E. qualification with administrative experience and considerable practice in the layout, operation and maintenance of H.T. and L.T. systems from generation to end use. Desirable age limit 40. Salary (incremental) from £1300 plus substantial allowances; free furnished quarters/messing or allowances in lieu. Biennial (paid) home leave. Married applicants must be prepared to serve singly for first 2 or 3 years. Write in full, quoting No. 31 to Box 3717, c/o, Charles Barker & Sons Ltd., 31, Budge Row, London, E.C.4. E5199 A.

TECHNICAL ASSISTANT ENGINEER wanted. Important Gold Mining Concern in West Africa has vacancy. Applicants should be not less than 25 years of age and have had sound technical training. Preference will be given to one with University degree or equivalent. Excellent prospects for young engineer to acquire experience while being trained as Assistant to the Chief Engineer with a view to executive position later. Salary not less than £80 per month. Tours of fifteen months followed by three months leave on full salary. Free passages, quarters, lighting and medical attention provided. Reply, stating age and full particulars to Box 6445, Whites, 72/78, Fleet Street, London, E.C.4. E5287 A.

The Steel Company of Wales Ltd., requires the services of an ASSISTANT PRODUCTION MANAGER for their Engineering Workshops covering all those Departments necessary for the efficient Maintenance of an integrated Iron and Steel Works. Applicants should be physically sound, age thirty to forty, educated to at least Higher National Certificate standard. Knowledge of modern machines and methods, time study, costing system and incentive schemes essential. Apply stating age, salary required and chronological list of education, training and career to the Superintendent, Personnel Services, P.O.Box No.9., Port Talbot, Glam. E5230 A.

The Sudan Light & Power Company require an ASSISTANT ELECTRICAL ENGINEER for service in their Khartoum Electricity Undertaking. Candidates should preferably be under 40 years of age and have at least three years experience in the Mains Departmentt of a progressive Electricity Supply Undertaking. Good technical qualifications and experience in the operation and development of Electrical Distribution Systems, including mod-

ern switchgear, underground cables and overhead lines, required. Emoluments from £E 760 to £E 1,012, depending on qualifications and experience, and whether married and number of children. Liberal leave, free passages and house. Residence will be in Khartoum, Sudan, where there is no Income Tax at the present time. Write, giving full details quoting ref. 774B, to Central Personnel Services, English Electric Co.Ltd., 24-30, Gillingham Street, London, S.W.1. E5207 A.

TRACER required for drawing office of large chemical works. Salary according to age and experience. Full canteen facilities and generous Non-contributory Staff Assurance Scheme. Apply to: Personnel Manager, Petrochemicals Ltd., Partington Industrial Estate, Urmston, M/cr. E5271 A.

TWO CIVIL ENGINEERING DRAUGHTSMEN required by general engineering firm on Tees-Side. To be capable of preparing drawings reinforced concrete work and have sound knowledge site surveying work. State age, experience, salary required. Address, E5216, The Engineer Office. A.

TWO GENERAL ENGINEERING DRAUGHTSMEN wanted by firm on Tees-Side. Accustomed to layout of plant, design of pressure vessels, platework, pipework etc. Give age, experience, salary required. Address, E5217, The Engineer Office. A.

TWO ELECTRICAL ENGINEERING DRAUGHTSMEN wanted by Tees-Side firm, General & Chemical Engineers. To be experienced in the design, layout, and installation of complete electrical equipment for gas, chemical and other plants. Apply giving age, experience salary required. Address, E5218, The Engineer Office. A.

TWO SENIOR JIG and TOOL DRAUGHTSMEN required by large light engineering Company in East London area for work on a new project which involves precision machining. Applicants should have amply practical experience as well as experience of jig and fixture design. Permanent positions with opportunity of promotion to planning engineer are open to suitable applicants. Kindly state full details including age and salary required. Address, E5197, The Engineer Office. A.

Vacancies exist in London Office of British Railways (Western Region) for the following: (a) STRUCTURAL DRAUGHTSMAN for preparation of designs and detail drawings of bridges, and (b) STEELWORK SURVEYORS for examination and estimation of strength of existing bridges. Previous experience desirable. Good prospects of permanency for right men. Application stating age and details of technical education and experience to Chief Engineer, Paddington Station. E5158 A.

Wanted by firm of Mechanical Handling Engineers ASSISTANT to OUTSIDE ERECTION MANAGER. Good opportunity for young man with practical and Drawing Office experience. Write stating age and salary required. Address, E3609, The Engineer Office. A.

Wanted ENGINEERS' MECHANICAL and STRUCTURAL CHIEF DRAUGHTSMAN to control a staff of 24. Age between 30 and 40. Experience in the design of cranes or excavators or commercial vehicles, preferably of at least 10 years. Apply by letter only, Messrs. R.H.Neal & Co.Ltd., Mobile Crane Manufacturers, Dysart Works, Grantham. E5174 A.

Wanted EXPERIENCED MECHANICAL DRAUGHTSMAN. Christy & Norris Ltd., Chelmsford, Telephone 3414. E3569 A.

Wanted EXPERIENCED CERTIFICATED ENGINEER to take charge of marine and general repair workshops in Brazil. Knowledge of Portuguese or Spanish will be helpful. State age, whether married or single, giving details of experience to Address, E3534, The Engineer Office. A.

West London manufacturers of specialised radio and electrical components require experienced MAN for Time and Motion Study/Ratefixing, or with adequate production background to justify training. Please write stating age, experience and present salary. Address E5241, The Engineer Office. A.

WORKS ENGINEER required for a Midlands Steel Foundry. Must be capable of taking charge of Maintenance Department and all future Development work. Assistance with a house may be available if necessary. Full details of training and experience to Address, E3623, The Engineer Office. A.

WORKS OFFICE ASSISTANT small Structural Engineers, London, experienced planning stock control, transport, etc. Good opportunity for young man not afraid of hard work, state age, experience and salary required to Box No. N.230, c/o, Marlows Advertising, 8, Blackfriars Road, S.E.1. E3614 A.

WORKS MANAGER for structural engineers, London area; 1st class practical man with experience all branches, good organiser, strict disciplinarian. Only men having held similar positions need apply. State age, experience and salary required to: Address, "C" Eng. E5164, The Engineer Office. A.

YOUNG ASSISTANT ENGINEER required for experimental and development work. Honours graduate preferred. Age, full particulars of qualifications and experience and salary required to Staff Office, Rowntree & Co.Ltd., York. E3518 A.

YOUNG men with Inter-B.Sc. standard at least required as TECHNICAL TRAINEES. Positions may involve shift work. Good prospects for applicants prepared to learn. Apply: Address, E5124, The Engineer Office. A.

SITUATIONS WANTED

CHEMICAL ENGINEER seeks change employment preferably not mobile. Experienced large scale chemical plant erection. Fabrication pipe and vessels including high vacuum - Argonac welding. Age 34. Salary £1200 p.a. Address, E3634, The Engineer Office. B.

CONSTRUCTION ENGINEER, wide experience oil installations, refinery plants, jetties etc, capable complete control foundations and all services. Excellent testimonials. Address, E3638, The Engineer Office. B.

DIECASTING EXECUTIVE. Long experience gravity and pressure processes, seeks position. Home Counties or provinces preferred. Address, E3613, The Engineer Office. B.

ENGINEER A.M.I.Mech.E., A.M.I.B.F. 27 years of age, requires appointment with good prospects. Willing to go abroad. Graduate Apprenticeship course with Company of world repute. Toolroom, Production Machine Shops, Press Tool Work, Mechanical Handling, Mechanised Foundries, Design, Layouts, Modifications, Structural Steelwork etc. At present Chief Draughtsman and Assistant Chief Engineer. Address, E3628, The Engineer Office. B.

PRODUCTION ENGINEER. 37 years of age, A.M.I.P.E., apprenticed, good education, well travelled. Extensive experience in precision engineering of Ratefixing, Estimating, Shop Foreman, Shop Manager, with an excellent production and labour relations record, desires change. Address, E3636, The Engineer Office. B.

Successful MANAGER, A.M.I.P.E., seeks position, General/Factory/Production. Aircraft, Filtration, Light Engineering, Vacuum Flasks, Mass Job Batch Production, Costs, Time Study, Production Control. At present Production/Methods Engineer. U.S.A. Available late Dec. Salary £1000. Resumé on request. Address, E3615, The Engineer Office. B.

AGENCIES

MANUFACTURERS desiring South African business should contact Commercial Engineer possessing 20 years S.A. experience with view to representation. Apply Skinner, 6, Warriston Crescent, Edinburgh. E3524 D.

REPRESENTATION. Experienced Mechanical Engineer, 37, is prepared to act as Agent. Sales; Buying; Progress; Technical, covering mainly Southern and Western Counties. Address, E3525, The Engineer Office. D.

SALES ENGINEER, long commercial experience, now representing leading manufacturers for home & export trade, seeks additional agency from established firms in engineering products. Special experience with Government Depts. Write Box Z.M.83, Deacon's, 36, Leadenhall Street, E.C.3. E5040 D.

EDUCATIONAL

For EXAMINATIONS in ENGINEERING you can study successfully, by post, under personal direction of Mr.J.A. Cormack, B.Sc., A.R.T.C., Whit. Ex. Write for particulars (free) to 34, Morton Gardens, Wallington, Surrey. E5109 E.

WANTED

Agricultural Engineers in Central Scotland require a second hand Straight Bed Centre Lathe S.S. and S.C. 9" centres, hollow spindle geared Head, to admit 12 ft. between centres. Standard A.C. voltage. Also one as above to admit 7 ft. between centres. Give full particulars re make, condition and price. Address, E3541, The Engineer Office. F.

Wanted - 4/5 - 33/40" dia. swing over saddle S.S.Sc. Lathes, to admit a min. of 14'0" between centres, direct motor drive, or belt drive will be considered Address, E5213, The Engineer Office. F.

Wanted: Aluminium Grindings and Bobbin Dust. Details of quantities to Address, E5236, The Engineer Office. F.

Wanted - Good secondhand Lathe for turning tyres and/or Journals on Railway Wagon Wheels. Address, E5286, The Engineer Office. F.

Wanted - New or modern secondhand Lancashire Boiler 28 ft. x 7'6" diameter or near. 100/120 lbs. working pressure. Full details to G.E.Simm (Machinery) Ltd., East Parade, Sheffield, 1. E5283 F.

Wanted - No. 4 or No. 5 Cincinnati Universal or Vertical Milling Machine, with swivel table, motorised for 3 phase supply, modern machine. Address, E5266, The Engineer Office. F.

Wanted - Modern motorised "Warner & Swasey" type 1A Turret Lathes, late type machine tools only required, electrical supply available 400/3/50 cycles. Address, E5249, The Engineer Office. F.

Offers Wanted. Three White's Marine Engineering Company's Low Pressure Oil Burning Equipment for 39,000 lbs. evaporation. Oil consumption 3,150 lbs. per hour. For specification of complete equipment apply, Waite & Heap Ltd., Clayson Chambers, 13, Carrington Street, Nottingham. E3612 F.

Wanted - One good secondhand, modern "Churchill" No. 2 Surface Grinder, motorised for 400/3/50 cycles supply. Address, E5062, The Engineer Office. F.

Wanted - One Good Secondhand 5-cwt capacity Steam Hammer. Price F.O.B. English Port. Address, E5045, The Engineer Office. F.

Wanted - Overhead electric travelling Cranes 3 - 3 ton capacity 30/34 ft. span. 1 - 3 ton capacity 38/40 ft. span. Voltage 400/3/50c. Full details to Address, E3607, The Engineer Office. F.

Wanted Re-conditioned Alternator Sets 200 to 500 kW. Steam engine or turbo driven complete with switchgear and transformers also boilers required. Characteristics 3000/3,300 or 6000/6,600 volts A.C. 50 or 60 cycles. Address, E3539, The Engineer Office. F.

Wanted: Taylor Hydracrane in good condition. William R. Selwood, Chandler's Ford, Hants. 'Phone 2275. E5058 F.

Wanted - Two Steam Engines, 400 H.P. Steam Pressure 120-lbs. per sq.inch, stop valve, against 10-lbs. back pressure. Address, E5106, The Engineer Office. F.

Wanted - Two Identical Hydraulic Presses, 1100 tons capacity, maximum die dimensions 5'6" x 3', stroke 2' daylight 1'6", Ram fully extended. Prices F.O.B. Address, E5180, The Engineer Office. F.

Wanted: 5 ton Overhead Electric Travelling Crane, 47 ft. span, 460 volts D.C. or 400/3/50 A.C. Address, E3640, The Engineer Office. F.

Wanted: 28" x 60" Single Spindle Cincinnati Hydro-Tel Milling Machine with 360° profile tracing head. Martin-Baker Aircraft Co.Ltd., Higher Denham, Nr.Uxbridge, Middx. E3583 F.

Wanted - secondhand 2-ton capacity Tropenas Convertor, complete with standard electrical gear for tipping and blowing equipment. Address, E5212, The Engineer Office. F.

Wanted - Up to 1,000-ft. of each 16", 18" and 24" bore steel tubes, preferably flanged. Suitable for 25 lbs. saturated steam. Please offer any quantity you have available to: Address, E5284, The Engineer Office. F.

Wanted - Secondhand Plain Horizontal Milling Machine, minimum length of table 60" motorised for 400/3/50 cycles supply. Address, E5248, The Engineer Office. F.

Wanted urgently. Cold Heading Machines, up to ½" capacity. Also wire forming machines, four-slide and used Auto's. Address, E3599, The Engineer Office. F.

FOR SALE

Mild Steel Plates (Blue condition) 5 tons 1.1/8 in., 5 tons 1.1/16 in., 8 tons 15/16 in., 25 tons ¾ in., 70 tons 11/16 in. In sizes 12ft. long x 2ft. 6in. to 4ft. wide. Full details supplied on request. Cox and Danks Ltd., Frederick Road, Salford 6. Telephone Pendleton 2491. E5205 G.

Shearing Machine. Double ended punching and shearing machine by "Craig & Donald". To shear up to ⅝in. To punch 1in.dia.hole in ⅝in. plate. Throat depth 3ft. Complete with new set of punches 3/8 in. to 1in. In excellent condition. Cox & Danks Ltd., Frederick Road, Salford 6, Telephone Pendleton 2481. E5204 G.

COMPRESSORS. 40,000 c.f.h. by Bellis & Morcom. Pressure 1175 lb.p.s.i. Four-stage. Direct driven by 300 H.P., 325 R.P.M. Induction Motor for 400/3/50 supply.
19,500 c.f.h. by Bellis & Morcom. Pressure 72 lb.p.s.i. Two-stage. Direct driven by 62 H.P., 420 R.P.M., Induction motor for 400/3/50 supply.
18,000 c.f.h. By Bellis & Morcom. Pressure 180lb.p.s.i. Two-stage. Direct driven by 86 H.P., 367 R.P.M. Induction motor for 400/3/50 supply.
9,000 c.f.h. by Waller. Pressure 60lb. p.s.i. Single-stage. Motorized for 400/3/50 supply.
336 c.f.h. by Broom & Wade. Garage type N.1. Pressure 100 lb. p.s.i. Single-stage. Motorized 2 H.P., 1440 R.P.M. Flameproof motor for 400/440/3/50 supply. Unit mounted with Air receiver on common base. NEW. Illustrated details supplied on Cox & Danks Ltd., c/o, B.O.C., Weldon Road, Corby, Northants. Telephone Corby 2203. E5203 G.

0-6-0 std. gge Steam Locos., by Hudswell Clarke & Co.Ltd., offered for sale by Civil Engineering Contractors. Four available ex London area. Cylinders 12" x 18", boiler pressure 160 lbs. Address, E3584, The Engineer Office. G.

Meters AC and DC, new and reconditioned, all types, Quarterly, single/three phase, 3 and 4 wire, 2½ to 1000 amps. Prepayment, single and double tariff, single, dual and triple coin, fixed and variable tariff, 2½ to 50 amps M.D.I.Billiard Switches, Rent Collectors. Price from 5/-d carriage paid two years guarantee, immediate delivery, illustrated catalogue from The Electric Meter Co., Castor Road, Brixham. E3495 G.

NORMAN E. POTTS (B'HAM) LTD., Offer the following Motorised Machine Tools.

Lodge & Shipley 9½" Lathe. 1½" H.S. 400/3/50.
De Laval Industrial Centrifugal Separator. Type 1529. 400/3/50.
Bradley & Turton Die Casting Press. with Fraser Mono Radial Pump. 400/3/50.
Diesel Electric Set. 35 K.W. 130 BHP.
Herbert No. 9 Comb Turret Lathe 3¼" HS. 400/3/50.
Smith & Coventry Hor Miller W/S 64" x 11" SPD.
Binns & Berry 6½" Gap Bed Lathe 1½" HS. 400/3/50.
Herbert No. 4 Chucking Capstan 2" H M. 400/3/50.
Drummond No. 1 Maxi-cut Lathe 11" HC x 22" BC.
Rhodes 30 ton Power Press 3½" Stroke. 400/3/50.
Clifton & Baird 30" Cold Saw Hydraulic feed 400/3/50.
Rapidor 6" Sawing & filing M/c. Adj. Stroke 400/3/50. E5219 G.

C.P.T. Portable Diesel Driven Air Compressor. 210 c.f.m. 100 lbs. w.p. with Caterpillar D.7 Engine. As new. Joseph Pugsley & Sons Ltd., Bristol,5. Telephone Bristol 56037. E5136 G.

LATHES - New 3½" Warwick £28. Hobson all geared £50. Littlejohn 5" £144. Used Atlas, Southbend, Grayson etc. New Bench Millers £69. New and used motorised bench Drills. Warwick 10" Shaper £98/10. Cash or Terms. Victa Engineering Co., Cordwallis Estate, Maidenhead. E5243 G.

SHEET METAL MACHINES - New Warwick Flypresses sizes 2 to 6 £10 - £23. Folders 36", 48", 72". Bending rolls 36" to 72". Guillotines 36" x 48". Terms arranged. Victa Engineering Company. Cordwallis Estate, Maidenhead. E5242 G.

Calculating Machine, BRUNSVIGA 15",in excellent condition for sale. Offers to Kontak Manufacturing Company Ltd., Grantham. E3610 G.

CONNELL OF COATBRIDGE

Offer the following new Government Surplus High Speed Twist Drills for immediate disposal.

TAPER SHANK.

Quantity.	Size.	Quantity.	Size.
35	2"	590	15/16"
38	1.7/8"	802	29/32"
11	1.13/16"	706	7/8"
48	1.3/4"	7	27/32"
99	1.5/8"	30	13/16"
88	1.9/16"	51	53/64"
36	1.1/2"	1247	25/32"
49	1.7/16"	330	3/4"
2	1.13/32"	15	23/32"
21	1.3/8"	2	45/64"
91	1.5/16"	686	11/16"
255	1.9/32"	83	43/64"
82	1.1/4"	193	19/32"
14	1.7/32"	1303	9/16"
81	1.3/16"	13	35/64"
341	1.5/32"	525	17/32"
43	1.1/8"	880	1/2"
1287	1.1/16"	1111	15/32"
215	1.1/32"	2644	9/32"
70	1.1/64"	1262	1/4"
561	1"	24	3/16"

PARALLEL SHANK.

1	2.3/8"	31	1.1/8"
1	2.5/16"	30	1.3/32"
4	2.1/4"	32	1.1/16"
1	2.1/8"	30	1.1/32"
4	2.1/32"	4	1.1/64"
11	1.15/16"	78	63/64"
9	1.7/8"	83	31/32"
8	1.53/64"	23	61/64"
2	1.13/16"	69	15/16"
34	1.49/64"	66	29/32"
10	1.3/4"	12	57/64"
5	1.23/32"	7	7/8"
6	1.45/64"	54	55/64"
6	1.21/32"	53	27/32"
5	1.41/64"	12	53/64"
5	1.5/8"	37	13/16"
5	1.19/32"	29	25/32"
7	1.15/32"	16	49/64"
4	1.29/64"	4	3/4"
18	1.7/16"	25	47/64"
6	1.13/32"	39	23/32"
1	1.25/64"	99	45/64"
29	1.3/8"	49	11/16"
9	1.11/32"	65	43/64"
1	1.21/64"	51	21/32"
5	1.19/64"	55	41/64"
9	1.9/32"	23	39/64"
13	1.17/64"	12	19/32"
33	1.1/4"	55	37/64"
35	1.7/32"	17	9/16"
11	1.5/16"	6	17/32"
2	1.11/64"	54	33/64"
16	1.5/32"	155	31/64"
21	1.9/64"		

Send for our Price List.

JAMES N.CONNELL LIMITED.
PHOENIX & CLIFTON WORKS,
COATBRIDGE. SCOTLAND.

Telephone Coatbridge 1121 (5 lines)

E5257 G.

1500 Ton Kieserling Double Sided Geared Toggle Action Blanking, Forming, Coining and Embossing Press, tie rod frame. 3" stroke. admit 3'3" wide, 4'3" daylight. Motor driven through double helical and spur gearing.

Reed Brothers (Engineering) Ltd.
Replant Works, Cuba Street,
Millwall, London, E.14.

Cables: Replant Pop London.

E5087 G.

RYDER-WELLMAN 4in. travelling spindle horizontal boring machine; motorised 400/3/50; table 54in. x 30in., 60in. longitudinal travel, 36in. cross travel; distance faceplate to outer support 86¼in; 16 spindle speeds in either direction 12 - 550 r.p.m., threads per inch, right or left-hand, 4,6,8,10,12,15,20,24,30; power rapid traverses. F.J.Edwards Ltd., 359, Euston Road, London, N.W.1. E5053 G.

FERRACUTE No. E.57 Toggle Embossing Press, pressure 1300 tons, stroke 2½in. between uprights 36 in., daylight 35in. Weight 45 tons.
NEW DE BERGUE No.34A. Automatic Geared Multiple Punching Machine, will handle plates up to 7 ft. 3 in. wide by 31 ft long, will punch 18 holes, 15/16in. dia. in ¾ in. plate, or six holes, 1.3/16 in.dia. in 1 in. plate at one stroke, punching pressure 425 tons. Punches may be worked singly or in groups; zigzag lines or holes can also be punched. Weight 42½ tons.
AUTOMATIC Double-End Flanging Machine with star wheel feed, capacity 3½ in. diameter by 12 in. long.
KARGES Hammer Automatic Double-End Body Flanging and Bottom Seaming Machine, stock feed to bottoms and conveyor and star feed to body, capacity from 2 in. to 4.7/16 in. diameter bodies, from 2 in. to 9½ in. high, output up to 2500 per hour.
SEVEN Deep Gap Power Punching Machines, stroke 3½ in., depth of gap 33 in., table 3½ in. by 6 in. hole in bed 1 in. Weight 12 cwt.
RUGGLES Shearing Machine with rotary travelling cutter, capacity 9 ft. long by 1/8 in. thick, cutter 9 in. diameter, driven by bevel gearing and travelling by means of rack and pinion, with automatic reversing motion.
MACHINE TOOLS, NEW and USED, Of every description. Attractive prices.
F.J.Edwards Ltd., 359-361, Euston Road, London, N.W.1. Telephone EUSton 4681 -3771. Telegrams: Bescotools, Norwest, London. E209 G.

FOR SALE. 7½ ton E.O.T. Crane, by Vaughan. 40'-0 span, 18'-0 lift, 3 motor type, cabin controlled. First class condition. Frank Salt & Co. Ltd., Station Road, Blackheath, Birmingham. E3588 G.

Farrer Economic Boiler - installed new 10.9.36. W.P.50 lb. Evaporation 3,000 lb. per hour. Size 13'0" x 7'0". Combustion chamber 2'0".
Paxman Economic Boiler, heating surface 565 sq. ft., Evaporation 2835/ 3402 lb. per hour. W.P. 50 lb. Size 12'6" x 6'6". Combustion chamber 3'0".
Two Boiler Feed Pumps (1 - Worthington Simpson 5.1/4" x 3.1/2" x 5").
Fuel Equipment (Rotaniser Burners, Electric Fuel Heater, Steam Fuel Heater, Weir Fuel Pump 2" x 3" x 5" and Plenty Rotary Pump size 0 - AG. 1.1/2 H.P.).
Also set of Bennet Grates for each Boiler (one forced draught fan).
Inspection invited.
Address, E3632, The Engineer Office. G.

Sherman Tank in thor. wkg. order, pow'd. by two 6/71 L.C. Dies. eng. App.C.I.Ltd., Argall Avenue, E.10. E5097 G.

One as new Patterson Hughes 10cwt. O/head elec. trav. Crane. For dets. Apply C.I.Ltd., Argall Avenue, E.10. E5096 G.

3000 ton Schloemann Horizontal Extrusion Press with piercing equipment, suitable for tubes and sections. Excellent condition. Address, E5032, The Engineer Office. G.

FOR SALE. 5 ton Smith Steam Loco Crane, 35 ft. Jib, Boiler 100 lbs. W.P.
5 ton Taylor & Hubbard Steam Loco Crane with 50 ft. Jib and Boiler for 100 lbs. W.P., suited for 4'8½" or 7'0" gauge.
10 ton Smith Steam Loco Crane, 25 ft. Jib, Boiler 100 lbs. W.P., 4'8½" gauge.
5 KW Generator Set with Lister Diesel Engine. Producing 230 volts D.C./22 amps at 1000 r.p.m.
12,000 lbs. capacity Overhead Electric Travelling Crane. 3 Motors for A.C. supply, 36 ft. span.
Dudley Vale Ltd., 3, Buckingham Place, S.W.1. Victoria 0252. E5108 G.

AIR COMPRESSORS FOR SALE
Two tool Air Pumps, portable petrol driven Compressor Plant, fitted Dorman Engine, mounted on Pneumatic tyres.
Two tool Holman, ditto, fitted Meadows Engine.
Two tool C.P.T. ditto. Fitted 6 cylinder Hercules Engine, mounted on four solid rubber tyres.
Two tool C.P.T. ditto. Fitted Ruston Hornsby 3 cylinder Diesel Engine, mounted on four solid rubber tyres.
CRANES FOR SALE.
2 ton Coles, fully slewing, Mobile Crane, mounted on pneumatic tyres, fitted Brand new Diesel Engine. Delivery six weeks.
2½ ton Morris, fitted Perkins Diesel, solid rubber tyres, non slewing.
5 ton Tate, fitted 30 h.p. Morris Engine, swan neck jib, solid rubber tyres, non slewing.
5 ton Coles Utility, fitted Fordson Petrol Engine, mounted on solid rubber tyres, fully slewing.
2 ton 90' span, King overhead travelling Crane, motorised 400/3/50, Cage control suitable outside use. Dismantled.
2 ton 35' span, Wharton overhead travelling Crane, hand operation throughout.
ENGINES FOR SALE.
12 h.p. at 600 r.p.m. National single cylinder, horizontal cold start, Diesel Engine, type J.B.
18 h.p. at 650 r.p.m. National ditto. Type N.P.H.
22 h.p. at 600 r.p.m. Blackstone ditto. Type O.P.
25 h.p. at 350 r.p.m. Mobery, ditto.
56 h.p. at 750 r.p.m. 3 cylinder vertical Deutz Marine, Diesel Engine.
65 h.p. at 2000 r.p.m. Perkins, ditto. Type P.6.M.
66 h.p. at 1000 r.p.m. Mac Claren,3 cylinder, vertical Diesel Engine. Unused.
100 h.p. at 1500 r.p.m. A.E.C. 6 cylinder, vertical, ditto.
165 h.p. at 1800 r.p.m. G.M.C. ditto. Type 671.
382 h.p. at 250 r.p.m. Ruston Hornsby ditto.
GENERATING SETS FOR SALE.
1½ K.W. 230/1/50 Onan, push button, petrol driven, generating set.
5.6 K.V.A. 230/1/50 Ford/Compton Parkinson, manual control, ditto.
4 K.W. 110 v. D.C. Petter/G.E.C. Petrol, ditto.
12 K.W. 230 v. D.C. Coventry Climax, ditto. New in packing case.
15 K.V.A. 400/3/50 Lister/Maudsley

Diesel, ditto.
22 K.W. 110 v D.C. Lister/Maudsley, ditto.
31 K.V.A. 230/1/50 Cummins/G.E.C. Diesel, ditto. Mounted on pneumatic tyres.
84 K.V.A. 220/3/50 Crossley, Diesel, ditto.
94 K.V.A. Mirlees/Metro. Vick, Diesel, ditto.
150 K.V.A. 400/3/50, Petter/Brush, Diesel, ditto.
CONTRACTORS PLANT FOR SALE.
Pegson 16" x 9" Diesel, Stone-crusher, fitted 20 h.p. single cylinder, Blackstone Engine. Mounted on four steel wheels.
Parker Diesel driven, ditto, Size 12" x 9".
Cletrac Type A.D. Diesel Crawler Tractor, fitted 4 cylinder 27 h.p. Hercules Diesel.
Fowler 4/40, ditto, fitted Hydraulic angle Dozer, with 7' blade.
Cletrac type D.D.H. ditto. Fitted 6 cylinder Hercules Engine, base Machine with Winch.
Cletrac, type D.D.H. ditto, fitted Cable operated Dozer.
Blaw-Knox cement pump, fitted Air Compressor and Electric Motor, whole skid mounted, totally enclosed. Could be fitted with Diesel Engine.
10-12 ton Aveling Barford, Diesel Roller, fitted Hydraulic Transmission and steering.
24" Liner Portasaws, fitted 5 h.p. J.A.P. Engine.
39" capacity Danarm Chain Saws, fitted 2½ h.p. Villiers Engine.
WELDING PLANT FOR SALE.
250 amp. Hobart Welding Set, fitted 6 cylinder Chrysler Petrol Engine, complete with canopy and side shields.
55" B.O.C. Profile Cutter, articulating arm, damage (easily repairable) one or two minor parts missing, otherwise perfect.

MATHEW BROTHERS,
"MATBRO WORKS"
SANDY LANE NORTH,
WALLINGTON, SURREY.

'Phone: Wallington 4050.
'Grams: "Matbro Wallington".

E5247 G.

VALES PLANT REGISTER LTD.
(Established 25 years)
Offer for sale:-
1 - CPT Type "Y" 2-Stage Double Acting 14" x 9" x 7" Compressor, 860 cfm, at 100 lbs. working pressure, 160 h.p. 440/3/50 Slip Ring Motor, complete with receivers.
1 - 15 ton Henderson Electric Derrick Crane, with 85'0" jib.
1 - 10 ton "Smith" Steam Locomotive Crane, 40'0" lattice jib, 4'8½" gauge.
1 - 5 ton "Smith" Steam Locomotive Crane, 35'0" jib, 4'8½" gauge.
1 - 3 ton "Smith" Steam Locomotive Crane, 30'0" jib, 4'8½" gauge.
1 - Fowler Diesel Driven Locomotive, 80 b.h.p., 0-4-0, 4'8½" gauge. First-class working condition.
Sole Agents for "Morgan" Derrick Cranes. Agents for "Weaver" Steam Cleaners, indispensable for degreasing, cleaning and paint stripping. Ideal for all Contractors Plant. Details on request.
Further details - 14 Lower Grosvenor Place, S.W.1. Tel: Victoria 3501.

E218 G.

THOMPSON Self-contained Economic type Boiler 14'6" x 8'6" diameter. 6,000/8,000-lbs.evaporation. 160-lbs.w.p. With complete BOILERHOUSE Equipment and self-supporting steel chimney.
Two RILEY Vertical Multitubular Boilers, 17'6" high x 7'0" diameter. 3,000-lbs.evaporation. 160-lbs.w.p.
NEW VERTICAL CROSSTUBE BOILERS - 13' x 6', 12'6" x 5'6", 12'3" x 5'0", 10'3" x 4'6", 9'x4', 8' x 4', 7'6" x 3'9" and 7' x 3'. 100-lbs.w.p.
Large selection of reconditioned vertical Boilers.
ASK FOR OUR BOILER STOCK LIST. JOSEPH PUGSLEY & SONS LTD.,BRISTOL,5. Tel. Bristol 56037. E 5047 G.

SPECIAL OFFERS
Two BROOMWADE Size 22A Electrical-driven Air Compressor Sets, 171/150-cu.ft.per minute. 100-lbs.w.p. Direct coupled with 30-H.P. 400/440 volts. 3 phase, 50 cycles slip ring Motors, complete with Starters, Air Receivers and Cooling Tanks.
Three 20 K.V.A. LISTER/MAWDSLEY Diesel Alternating Sets, 400/440 volts. 3 phase, or 210/230 volts. single phase, 50 cycles.
UNUSED 16" x 9" "Goodwin-Barsby" Portable diesel-driven Stonecrusher and Screen.
Five OPEN TOP STEEL TANKS 30' x 6' x 8'6" deep, of welded construction from 5/16" plate. Strongly supported externally, clear inside. Capacity 9,000 gallons.
BRAITHWAITE Sectional Steel Tank 16' x 16' x 8' deep, with steel tower.
JOSEPH PUGSLEY & SONS LTD., Bristol,5. Tel: 56037. E 5044 G.

ONE 350 K.W.Mirrlees Diesel Driven Alternator Set. 400/3/50.
FOUR 275 K.W. Ruston Vertical Diesel Driven Generating Sets. 220 V. D.C.
ONE 168 B.H.P. Ruston Horizontal 250 R.P.M. Oil Engine driving 172.5 K.V.A. B.T.H. Alternator 420/230 volts, 3 phase, 50 cycles, 4-wire, 750 R.P.M.
ONE 100 K.V.A. 400/3/50 Brown-Lindley/Westinghouse Steam Generating Set, 120 lb.p.s.i.working pressure.
ONE 85 K.V.A.Blackstone/Crompton Parkinson Slow-speed direct coupled Diesel Alternator Set 400/3/50, 250 R.P.M.
TWO 50 K.V.A. G.M/Alpha Harris Vertical Diesel Alternator Sets, 400/3/50.
TWO 40 K.V.A. Crossley/Crompton Parkinson 400/3/50 Diesel Alternator Sets with synchronising Switchboard.
ABELSON & CO.(Engineers)Ltd., 333, Station Road, Harrow,Middx. Tel: Harrow 2253 E 5088 G.

BOILERS
FOR IMMEDIATE DELIVERY
New - Farrar 11' high x 4'9" diameter crosstube vertical Boiler evaporation capacity 1,110 lbs per hour, working pressure 100 lbs per square inch. Complete with mountings and fittings, and injector.
New - Farrar 10'3" high x 4'6" diameter, vertical crosstube Boiler evaporation capacity 950 lbs per hour working pressure 100 lbs per square inch. Complete with mountings, fittings and injector.
New - Farrar 9' high x 4' diameter, vertical crosstube Boiler evaporation capacity 720 lbs per hour, working pressure 100 lbs per square inch. Complete with mountings, fittings and injector.
New - Coltman 9' high x 4' diameter, vertical crosstube Boiler evaporation capacity 720 lbs per hour, working pressure 100 lbs per square inch Complete with mountings, fittings and injector.
New - Coltman 8'6" high x 3'6" diameter, evaporation capacity 550 lbs per hour, working pressure 100 lbs per square inch Complete with mountings, fittings and injector.
---FROM STOCK---
John Cashmore Limited,Engineers, Newport, MON. Tel: 3944(3 lines)

E5048 G.

One secondhand CHAMBERSBERG 35,000 lbs.Model E.Drop Hammer, Cylinder Bore 40", Stroke 60", Distance between Vees 54", Ram, front to back 55", Diameter of Air or Steam inlet 10", Diameter of Exhaust 12", Approximate weight 525 tons. Drawing on application. JOHN CASHMORE Ltd., Great Bridge, Staffs. Tel:Tipton 2181

E5043 G.

VALES PLANT REGISTER LTD.
(Established 25 years)
Offer for sale:-
1 - 10 ton "Smith" Steam Locomotive Crane, 40'0" lattice jib, 4'8½"gauge.
1 - 5 ton "Smith" Steam Locomotive Crane, 35'0" jib, 4'8½" gauge.
1 - 3 ton "Smith" Steam Locomotive Crane, 30'0" jib, 4'8½" gauge.
1 - Bagnall 0-4-0 Locomotive, 14" Cylinders, 4'8½" gauge. Completely overhauled.
1 - Fowler Diesel Driven Locomotive, 80 b.h.p., 0-4-0, 4'8½" gauge. First-class working order.
Agents for "Weaver" Steam Cleaners, indispensable for degreasing, cleaning and paint stripping. Ideal for all Contractors Plant. Details on request.
Further details - 14,Lower Grosvenor Place, S.W.1. Tel: Victoria 3501.

E218 G.

VALES PLANT REGISTER LTD.
(Established 25 years)
Offer for sale:-
1 - 30 K.V.A.Alpha Harris Alternator, suitable for 400/230 volts, 3-phase, 50 cycles A.C.with switchboard.
1 - 50 K.V.A.Alpha Harris Alternator, suitable for 400/230 volts, 3-phase, 50 cycles A.C.with switchboard.
1 - 100 K.V.A.Alpha Harris Alternator, 400/230 volts, 3-phase, 50 cycles A.C. together with switchboard.
1 - 60 K.W. 400 volts, 3-phase, 50 cycle, 4-wire Diesel Alternator Set, including Blackstone diesel engine, together with switchboard. Very little used.
1 - 84 b.h.p. 500 r.p.m. National Vertical Diesel Engine.
Further particulars - 14, Lower Grosvenor Place, S.W.1. Telephone: Victoria 3501.

E218 G.

NEW DIESEL DRIVEN CENTRIFUGAL PUMPING SETS.
150 GPM/110ft.head.3" Single-stage Pump by Pulsometer type LEX-3, direct coupled on bedplate to 1-VSH Ruston Hornsby Diesel.
400 GPM/90ft.head. 4" Single-stage Pump by Pulsometer type LEX-4,direct coupled on bedplate to 2-VSH Ruston Hornsby Diesel.
ENQUIRY DETAILS. With enquiries, kindly furnish the following data, estimated quantity and total head in ft. if water or other liquid. Re: motor: type of enclosure preferred.
BERRY HILL PLANT DIVISION, Cheadle Staffs. Tel: Cheadle 2181 & 2261.

E5127 G.

C.W.B Vertical and Horizontal Boring Machines. Enquiries for these famous machines to Thos.W.Ward Ltd.,Albion Works, Sheffield.

E5214 G.

Immediate Disposal - 5 very good secondhand 30 x 9 Horizontal Cylindrical Tanks. Price £185. O. O. each loaded on to rail or road vehicle on site Cornwall. Thos.W.Ward Ltd.,Brettenham House, Lancaster Place, Strand, London,W.C.2.

E5107 G.

NEW ELECTRICALLY-DRIVEN CENTRIFUGAL PUMPING SETS.

UNITS UP TO 100 FT. HEAD.

55 GPM/50ft.head. 2" Single-stage Pump type CF200, direct coupled on bedplate to 2 H.P.S.C.1425 RPM Motor, 400/440-3-50.

90 GPM/20 ft.head.2" Single-stage Pump by Pulsometer type K2, direct coupled on bedplate to 1½ H.P.S.C. 1425 RPM Motor, 400/440-3-50.

125 GPM/90 ft.head. 1½" Single-stage Pump by Pulsometer type LEX-1½,direct coupled on bedplate to 7½ H.P.S.C.1440 RPM Motor,400/440-3-50 or 500/550-3-50.

175 GPM/88ft.head.2" Single-stage Pump by Pulsometer type LEX-2, direct coupled on bedplate to 10 H.P.S.C. 1440 RPM Motor,400/440-3-50 or 500/550-3-50.

200 GPM/50ft.head. 4" Self-priming Single-stage Pump by Pulsometer type KPX-4, direct coupled on bedplate to 7½ H.P.S.C.1440 RPM Motor, 400/440-3-50 or 500/550-3-50.

250 GPM/40 ft.head.3" Single-stage Pump type CF310,Direct coupled on bedplate to 7½ H.P. S.C.1440 RPM Motor, 400/440-3-50 or 500/550-3-50.

325 GPM/100 ft.head.3" Single-stage Pump by Pulsometer type LEX-3,direct coupled on bedplate to 15 H.P.S.C. 1450 RPM Motor, 400/440-3-50 or 500/550-3-50.

400 GPM/43ft.head.4" Single-stage Pump by Pulsometer type A4, direct coupled on bedplate to 10 H.P.S.C. 1440 RPM Motor, 400/440-3-50 or 500/550-3-50.

450 GPM/27 ft.head. 4" Single-stage Pump type CF410, direct coupled on bedplate to 10 H.P.S.C. 1440 RPM Motor,400/440-3-50 or 500/550-3-50.

600 GPM/35ft.head.5" Single-stage Pump by Pulsometer type K5, direct coupled on bedplate to 15 H.P.S.C. 1450 RPM Motor,400/440-3-50 or 500/550-3-50.

750 GPM/100ft.head. 4" Single-stage Pump by Pulsometer type LEX-4, direct coupled on bedplate to 40 H.P.S.C. 1450 RPM Motor,500/550-3-50.

800 GPM/70ft.head.5" Single-stage Pump by Pulsometer type LEX-5, direct coupled on bedplate to 28 H.P.S.C. 955 RPM Motor,400/440-3-50.

UNITS OVER 100 FT. HEAD

14 GPM/300ft.head.1½" 2-stage self-priming pump by G.G.G.type 125 BS, direct coupled on bedplate to 5 H.P. S.C.Motor, 2900 RPM,400/440-3-50.

50 GPM/430ft.head.1½" Turbine Pump by Gwynne type P1½/6, direct coupled on bedplate to 5 H.P.S.C.Motor,2900 RPM, 400/440-3-50 or 500/550-3-50.

60 GPM/140ft.head.1½" Single-stage Pump by Pulsometer type BEMX-1½,direct coupled on bedplate to 5 H.P.S.C. Motor, 2900 RPM,400/440-3-50.

80 GPM/150ft.head. 2" 2-stage Pump by Pulsometer type HSRB-2, direct coupled on bedplate to 7½ H.P. S.C. Motor, 1440 RPM 400/440-3-50 or 500/550-3-50.

110 GPM/400ft.head.1½" 2-stage Pump by Pulsometer type HSRB-1½,direct coupled on bedplate to 30 H.P.S.C.Motor, 2900 RPM,400/440-3-50 or 500/550-3-50.

125 GPM/400ft.head.2" Turbine Pump by Gwynne type P2/4, direct coupled on bedplate to 30 H.P.S.C.Motor,2900 RPM 400/440-3-50 or 500/550-3-50.

175 GPM/480ft.head.4" 2-stage Pump by Mather & Platt, type 4"/6" CH.Pluro, direct coupled on bedplate to 70 H.P. S.C.Motor, 2950 RPM,400/440-3-50.

250 GPM/175ft.head.3" 2-stage Pump by Pulsometer type HSRB-3, direct coupled on bedplate to 25 H.P.S.C.Motor, 1450 RPM,400/440-3-50 or 500/550-3-50.

350 GPM/185ft.head.4" 2-stage Pump by Pulsometer type HSRB-4, direct coupled on bedplate to 30 H.P.S.C.Motor,1450 RPM,400/440-3-50 or 500/550-3-50.

400 GPM/150ft.head.4" Single-stage Pump by Pulsometer type LEX-4, direct coupled on bedplate to 30 H.P.S.C.Motor, 1450 RPM,400/440-3-50 or 500/550-3-50.

500 GPM/420ft.head.6" Turbine Pump by Pulsometer type T6 s/6, direct coupled on bedplate to 100 H.P.S.C.Motor,1460 RPM,500/550-3-50.

600 GPM/150ft.head.5" 2-stage Pump by Pulsometer type HSRB-5,direct coupled on bedplate to 50 H.P.S.C.Motor, 1460 RPM,400/440-3-50.

750 GPM/118ft.head. 5" Single-stage Pump by Pulsometer type LEX-5,direct coupled on bedplate to 45 H.P.S.C. Motor, 1460 RPM, 400/440-3-50.

PHONE 98 STAINES

Broadbent 48" Elec.Underdriven Hydro. Two Elec.Five Roll W.C.Steel Refiners by Baker Perkins.
"Torrence" Positive Driven Edge Runner 6' dia. pan.
"Johnson" Jac.Elec.Filter Press Pump, 420 g.p.h.
Lancashire Boilers: 30' x 8'6" and 28' x 8' diam, 140 and 150 lbs w.p.
Vert.Crosstube Boilers: 11'6" x 4'6", 120 lbs w.p., 7'6" x 3'6" and 7' and 3'3", 100 lbs w.p.
Cyl.,Rectangular and Sectional Tanks up to 16,000 gallons.
HARRY H. GARDAM & CO.LTD., STAINES.

E101 G.

INDUSTRIAL BUILDINGS FOR SALE. Steel, asbestos and timber buildings including "Blister" hangers, "Romney" huts, timber army huts, office type buildings, canteens, public halls, etc. Carriage paid. Prompt despatch. Write now for details to J.Thorn & Sons, Ltd.,Box 37, Brampton Road, Bexleyheath, Kent. Tel:Bexleyheath 305

E113 G

"Precimax Universal Grinder, capacity 12" x 36". Internal spindle, modern machine fully motorised 400/3/50. H.Bell (Machine Tools) Ltd., Walter Street, Leeds, 4. E185 G.

FOR IMMEDIATE SALE.
One set Four-Roller Type PLATE STRAIGHTENING ROLLS, by Craig and Donald,Ltd.,capacity 12ft.wide by ⅝" thick, arranged belt drive from electric motor.
ONE Steel Plate Frame PLATE STRAIGHTENING PRESS, by James Bennie and Sons, gap 21in.deep, capacity 3/8"., motorised.
ONE Lever Type PUNCHING and SHEARING MACHINE, by Bennie, 5/8" capacity, motorised.
ONE Equal New "Westminster" ELECTRIC TUBE BENDER, capacity ½in.,400/3/50 A.C.
ONE Sentinel Vertical, Intercooling AIR COMPRESSOR, by Alley and Maclellan, capacity 400 cu.ft.free air per minute, 100 lb.pressure.
Also numerous LATHES, Plain and Universal MILLING MACHINES, SLOTTERS, etc.
ONE No.7 Ward All-Geared Head, Motorised CAPSTAN LATHE, 440/3/50 A.C. and Connections.
ONE 200 H.P.SQUIRREL-CAGE MOTOR, by Sandycroft, 440/3/50 A.C.,speed 495 r.p.m., mounted base-plate, slide rails, Ellison starter.
ONE No.3B HORIZONTAL "MILWAUKEE" UNIVERSAL MILLING MACHINE, arranged for motor drive, 4 H.P. motor included.
ONE DOUBLE-HEADED MILLING SCARFING MACHINE, by Noble and Lund, two slotted tables, fully motorised.
ONE Kendal and Gent HORIZONTAL SURFACE GRINDER, capacity 4ft. by 2ft., motorised through 440/3/50 A.C.,plus belt.
Several 18in. SHAPING MACHINES, American type, both cone and motorised.
LATHES, 6in. to 18/20in.,straight and gap beds, solid and hollow spindle, length of beds 12/30ft.
Further particulars and prices from John H.Riddel,Ltd.,62,Robertson Street, Glasgow,C.2.

E155 G.

Practically new Trianco Electric batch conveyor for sale, complete with all electrical equipment, 60 ft. steel gantry runway and automatic stops etc. Perfect condition.
Unused Liner 18" x 9" Slab and Block machine, capacity up to 6" thick blocks.
New Winget Plate Tamp Slab Machine, 18" x 9" up to 6" thick.
New "Lee" Block Machine, 17.5/8" x 8.5/8" for plain or tongue and groove blocks up to 6" thick.
New Rigid Block Machine 18" x 9", up to 9" thick, with single and double cavity fittings.
Secondhand Trianco 2G Hand Operated Slab and Block Machine with electric jolter and 400 pallets. Set to make 18" x 9" x 9" double cavity blocks.
Benford Regulus B.R.25 Automatic Continuous Concrete Mixer, Diesel driven, completely rebuilt by Makers. Full range of spares always in stock.
Also full range of Concrete Mixers, new and secondhand, from 4/3 cu.ft. capacity.
WILLIAM R. SELWOOD, CHANDLER'S FORD, HANTS. 'Phone 2275. E5273 G.

FOR SALE. Petrol Generator 800 Amps at 7.5 volts or 400 Amps at 15 volts or 2 circuits 400 amps at 7.5 volts. Unused £150. Apply to the Buyer, Dyson & Co. Enfield (1919) Ltd., Southbury Works, Ponders End, Middx. Howard 1484. E5267 G.

FOR SALE. Diesel Driven Alternators two by Fowler, 1944 make unused. 4 cylinder vertical type engines of 71 B.H.P. 1300 RPM driving by "V" ropes Lancashire Dynamo and Crypto alternators 1500 RPM. Output 58 K.V.A., .8 power factor, 400/440 volts, 50 cycles, 3 phase, continuous rating. Self-contained on steel framing and fitted with water cooling system. Complete with switchboard., automatic voltage control, and synchronising equipment. £1250 each. Apply to the Buyer, Dyson & Co. Enfield (1919) Ltd. Southbury Works, Ponders End, Middx. Howard 1484. E5268 G.

FRED WATKINS
RECONDITIONED MACHINERY FOR SALE.
STEAM BOILERS.-Danks Economic,14ft.by 8ft.,new 1940, automatic stokers; two Lancashire, 30ft. by 9ft.3in.,190 lb; two Cochran, 14ft. by 6ft.6in.,150 lb. W.P.; brand new Farrar Economic, 3000 lb.evaporation, 120 lb.W.P.; 400 Boilers always in stock.
AIR COMPRESSORS.- new 1942; Ingersoll-Rand, 450 cu.ft.; C.P.T.,320 cu.ft; Broomwade,220 cu.ft.; Holman,100 cu.ft. all motorised, 100 lb.pressure.
200 Air Receivers stocked, including four 8ft..by 4ft. 3in. by 250 lb.; six, 24ft. by 4ft. by 150 lb.; twenty, 7ft. by 3ft. 4in. by 100 lb; all tested and guaranteed.
DIESEL ENGINES.-Twenty Lister, 3-cyl. and 4-cyl.,vertical,as new, 30/40 H.P.; Ruston, 90 H.P.,vertical; Ruston 28/31 H.P., Ruston 24/26 H.P.
CRANES.-5-ton Tate mobile petrol-electric, new 1942, three in stock; 3-ton Jones mobile, slewing, diesel driven; 3-ton Morris hand-operated, swan-neck jib; 5-ton Booth steam loco.,new 1942, 40ft.jib, shunting type; 5-ton Grafton shunter, 1943, jib 35ft.; 3-ton Smith steam loco., 40ft. jib.
GENERATING SETS.-20kVA Lister diesels, 230/3/50 supply, practically new; 15-kVA Lister diesels, 440/3/50 and 230/1/50 supply; 18-kW Ruston diesels, 110 volts D.C., trailer mounted; new 1½ and 5-kVA petrol, 230/1/50 output.
RAILWAY MATERIAL.-Stephenson 12in.by 20in.,standard-gauge steam loco., new 1946, 165 lb.pressure, copper firebox; 30 tons 75-lb.F.B.rails; 2000 yards 20-lb.track, 2ft.gauge, with turntables, points, wagons.
STEEL SECTIONS.-100 tons 2½in. by 2½in. by ½in.angles, 6ft.4in.lengths; 100 tons angles, 2in. by 2in. by ½in., 15ft.3in. lengths; 60 tons, 1½in by 1½in., 8ft. 3in. lengths, as new.
ELECTRIC MOTORS.-300 H.P.,G.E.C.,S.R., 334 r.p.m.; 60 H.P.,G.E.C.,S.R.,480 r.p.m.,three as new; 50 H.P.,L.D.C.,T.E., S.R.480 r.p.m., 50 H.P.,Harland,T.E., S.R.,1460 r.p.m.,35 H.P.,Laurence Scott, T.E.,S.C.,flameproof,990 r.p.m.
STEEL PIPING.-20,000 feet,each ¾in., 1¼in.,1½in., 3in. and 4in., screwed and socketed, 15/20ft. lengths; 12,000 feet 6in.Victaulic, 15/20ft., unused, new joints; 200 feet12in. high-pressure flanged steel steam main; 4000 feet 5in., 2000 feet 10in. as new; 1000 feet 30in.riveted steel tubing for exhaust, gas, chimneys. 10,000 stop valves, steel G.M. and C.I., up to 48in.,reconditioned and tested.
Further details in "Watkins Machinery Record," published monthly; free copy on request.
SLING ENGINEERING WORKS
COLEFORD, GLOS.
'Phone, Coleford 2271/2.
E5277 G.

FOR SALE. "Economic" Steam Boiler (Farrar Ltd.) 100 lbs. per sq. in. pressure - 5500/6000 lbs. per hour evaporative capacity with "I.V.O." automatic stoking and steam fittings. Messrs. Henry Smith (Constructional Engineers) Ltd., Wharton Steelworks, Deakins Road, Winsford, Cheshire.
E3635 G.

Copper Capillary Tubing 3/32" x 1/64" Suitable for thermometers. Going cheap. Giving up business. Price £15.0.0. per 1000 ft. or near offer. Address, E3637, The Engineer Office.
G.

Straightening Press and Equipment, Mills 15 ton hydraulic, motorised complete, unused, at £350.0.0. Henry Milnes Ltd., Ingleby Lathe Works, Bradford.
E5282 G.

VALES PLANT REGISTER LTD.
(Established 25 years)
Offer for sale:-
10 ton "Smith" Steam Locomotive Crane, 40'0" lattice jib, 4'8½" gauge.
5 ton "Smith" Steam Locomotive Crane, 35'0" jib, 4'8½" gauge.
3 ton "Smith" Steam Locomotive Crane, 30'0" jib, 4'8½" gauge.
Bagnall 0-4-0 Locomotive, 14" cylinders, 4'8½" gauge. Completely overhauled.
Fowler Diesel Driven Locomotive, 80 b. h.p., 0-4-0, 4'8½" gauge. First-class working order.
Agents for "Morgan" Derrick Cranes.
Agents for "Weaver" Steam Cleaners, indispensable for degreasing, cleaning and paint stripping. Ideal for all Contractors Plant. Details on request.
Further details - 14,Lower Grosvenor Place, S.W.1. Tel: Victoria 3501.
E219 G.

NORMAN E. POTTS (B'HAM) LTD.,
Offer the Following Motorised Machine Tools.

Bradley & Turton Die Press. Adjustable Stroke. Motorised 400/3/50.
De-Laval Oil Separator. Type 1529. 150 Gal. Storage Tank. Motorised 400/3/50.
Herbert No. 4 Chucking Capstan. 2" HM. 400/3/50.
Kendall & Gent Milling & Boring Machine 30" dia. Rotary table. 400/3/50.
Lodge & Shipley 9½" Lathe 1¼" HS. Taper Turning. 400/3/50.
Herbert No. 9. Comb Turret Lathe. 3¾" HS. 400/3/50.
Ronceray Moulding Machine. Table 20" x 20". Throat 12". Daylight 12".
Lo-Swing Lathe. 8" x 60" Motorised.
Edwards 40 ton Power Press 4" Stroke. 400/3/50.
B.U.S. No. 3. Ideal Clicking Press. 36" x 18" Table.
Wadkin 36" Circular Saw Bench. Model S.R.V. 400/3/50.
Diesel Electric Set. 35 K.W. 130 BHP.
E5290 G.

FOR SALE. Compressor Set by J. Browett Lindley Ltd., Vertical type 150 C.F.M. Driven by English Electric Co. Induction Motor 32 H.P. 400/440, 3 phase, 50 cycles, continuous rating. Controlled by Igranic Vertical Cabinet Air Receiver 3'0" O.D. x 6'0". Working Pressure 100 lbs. sq. in. Thoroughly overhauled. £400. Apply to the Buyer, Dyson & Co., Enfield (1919) Ltd., Southbury Works, Ponders End, Middx. Howard 1484. E5269 G.

AUCTIONS

By Order of the Receiver,
Re: Medcalfe & Co.Ltd.,
Champion Works,
St. Helens Trading Estate.

BISHOP AUCKLAND

Nearly New
MACHINE TOOLS and EQUIPMENT.

Ward 2A and 3A Motorised Capstan Lathes.
Dean Smith 7" Super High Speed Production Lathe.
Herbert Electric Pedestal Drills.
Archdale 3 ft. ELECTRIC RADIAL DRILL.
Cincinnati Universal Tool Grinder.
Bench Grinders, Bandfacers.
Kearns Type OA ALL GEARED HORIZONTAL BORING MACHINE.
Cincinnati Model 2P High Speed Milling Machine.
NICKEL PLATING PLANT.
Rectifiers, Polishing Lathes;
Water Back Spray Booth.
Shot Blast Plant;
Thermostatic Stoving Oven.
Engineers Inspection and Hand Tools.
Steel Store Racking.
Modern Office and Drawing Office Furniture.

LEOPOLD FARMER & SONS will sell the above BY AUCTION at the

KINGS HEAD HOTEL,
DARLINGTON

at an early date.

On view two days prior and morning of sale.
The Lease of the Modern Ground Floor Factory, occupying approximately 13,000 square feet is for disposal.

Catalogues of Leopold Farmer & Sons, Industrial Property, Plant and Machinery Auctioneers, 46, Gresham Street, London, E.C.2. Telephone: MONarch 3422 (8 lines) E5226 J.

By Order of the Ministry of Supply.
Third Sale.

G. R.

MINISTRY OF SUPPLY STORAGE DEPOT
ELSTOW
4 miles South of
BEDFORD
(On the Bedford to Luton Road.)

PEACOCK, MERRY and SWAFFIELD will SELL by AUCTION & on the SITE on TUESDAY, 14th, November, 1950 at 11 a.m.
ENGINEERING, ELECTRICAL & MISCELLANEOUS EQUIPMENT & STORES
Including:-
Thorneycroft Coles Crane;
Muir-Hill Dumpers;
Narrow gauge Locomotives;
Power Concrete Mixers;
Electric Generators and other equipment;
Pedal cycles;
Bedding;
Clothing;
Bootmaking equipment and stores;
Agricultural hand tools;
Borehole pumps;
Water filters;
Scrap batteries and other scrap metals, etc. etc.

ONE LOT will be sold at ELSTOW "as lying" at another Depot.

ON VIEW: 10th and 13th November, 1950 ... from 9 a.m. to 4 p.m. each day. On Sale Day ... from 9 a.m. to 11 a.m.
CATALOGUES: Price 6d. (P.O. ONLY no stamps) Admit One Person on Sale Day, Two Persons on View Days.

AUCTIONEERS' OFFICES: 10, LIME ST., BEDFORD. Telephone 66366/7.
E5291 J.

PUBLIC NOTICES

RIVER TRENT CATCHMENT BOARD

APPOINTMENT OF ENGINEERING ASSISTANTS

Applications are invited for the appointment of ENGINEERING ASSISTANTS at the Board's District Offices at Gainsborough and Keadby.

The salaries will be in accordance with the scales of the National Joint Council for Local Authorities' Administrative, Professional, Technical and Clerical Services ranging from A.P.T. Grade I to A.P.T. Grade V, according to applicants' experience and qualifications.

Preference will be given to candidates holding prfoessional qualifications or possessing a University Degree, and who have had experience and qualifications.

Written applications for the above appointments accompanied by copies of testimonials, should be delivered to the undersigned within fourteen days of the appearance of this advertisement.

WALTER H. HAILE O.B.E., M.I.C.E.
Engineer to the Board.

Catchment Board Offices, Derby Road, Nottingham. E5336

SOUTH-EASTERN REGIONAL HOSPITAL BOARD, SCOTLAND

Applications are invited for the superannuable appointment of CHIEF REGIONAL ENGINEER at a salary scale of £1,350 by £50 to £1,550 per annum.

Applicants must be engineers of professional standing and preferably should be Corporate Members of either the Institute of Civil Engineers, the Institute of Mechanical Engineers, or the Institute of Electrical Engineers, with wide experience of all branches of engineering design and operation.

Applications giving full particulars of qualifications and experience, together with the names and addresses of three referees should be forwarded to the Secretary to the South-Eastern Regional Hospital Board, Scotland, 11 Drumsheugh Gardens, Edinburgh 3, not later than 30th November, 1950. E5332

MINISTRY OF SUPPLY

MAINTENANCE GROUP ENGINEER required by the Division of Atomic Energy (Production), Windscale Works, Sellafield, Cumberland, to be responsible to the Work's maintenance engineer for maintaining, and occasionally modifying, mechanical, hydraulic and pneumatic equipment associated with atomic piles. This equipment includes complex servo mechanisms, large capacity blowers and lifting and handling machinery. Responsibilities will also include organisation of a scheduled group maintenance system and control of engineers and craftsmen.

Candidates must have served a mechanical or electrical engineering apprenticeship and have either an engineering degree or corporate membership of the Institution of Civil, Mechanical or Electrical Engineers or equivalent qualifications. They should have had at least three years' responsible experience of the type of equipment mentioned above and have had experience in the control of staff. A house will be available within a reasonable period for the successful candidate, if married.

Salary will be assessed according to qualifications and experience within the range £720 - £960 p.a. Applications to Ministry of Supply, D.At. Eng.(P) Risley, nr. Warrington, Lancs. E5331.

THE ADMIRALTY

Vacancies exist at the Admiralty Engineering Laboratory, West Drayton, for DEVELOPMENT ASSISTANTS for experimental and development work in connection with electrical equipment of warships.

Candidates must be British subjects and should normally have served an engineering apprenticeship or have had equivalent workshop experience and possess Higher National Certificate in Electrical Engineering or acceptable equivalent.

Experience in laboratory work will be an advantage for all posts and a knowledge of applications of electronic and telecommunication techniques to engineering development will be an advantage for certain posts.

Appointments will in first instance be on a temporary basis, but there will be an early opportunity to compete for established appointments.

Commencing salary will be assessed according to age, qualifications and experience within the range £470-£595 p.a. Prospects exist of promotion to Senior Development Assistant grade (£595 - £720 p.a.)

Applications stating age, technical qualifications, apprenticeship and subsequent experience should be addressed to Admiralty, C.E. II, Room 88, Empire Hotel, Bath. E5330.

ALFORD DRAINAGE BOARD ENGINEER

Applications are invited for appointment to the Board as qualified CIVIL ENGINEER. Experience in land drainage maintenance and improvement works, including the design, construction and control of pumping plants and on sea defence works, including heavy piling and designing of re-inforced concrete desirable. Salary between £700 and £900 according to experience, the successful candidate providing a car and receiving travelling expenses on the Board's scale. The Local Government Superannuation Act, 1937, will apply. Applications, stating name, age, qualifications and experience, together with the names of three referees, must be received by the undersigned not later than the 27th October 1950.

J.R.TINN, Clerk to the Board, 6 High Street, ALFORD, Lincolnshire. E5159.

LONDON COUNTY COUNCIL CHIEF ENGINEER'S DEPARTMENT

ASSISTANT RESIDENT ENGINEERS required on the construction of Sedimentation Tanks at Northern Outfall Works, Beckton, E.6. The work will entail the construction of large tanks, channels and culverts in reinforced concrete on piled foundations, pipelines, roads, etc. Applicants should have had experience in setting out and supervising such work. The vacancies are for assistants with salaries (a) up to £700 and (b) up to £580 a year. Application forms obtainable by sending stamped addressed foolscap envelope to the Chief Engineer, The County Hall, Westminster Bridge, S.E.1. (Quoting Vacancy No.50/38), returnable in fourteen days after the appearance of this advertisement. Canvassing disqualifies. (1296) E5099.

WEAR AND TEES RIVER BOARD APPOINTMENT OF CHIEF ENGINEER

Applications are invited for the above appointment on the staff of this Board which has recently been constituted under the River Boards Act,1948. The Chief Engineer will be responsible for the control and execution of land drainage and other engineering works for the Board. Applicants should be Corporate Members of the Institution of Civil Engineers, or hold equivalent qualifications and should have considerable experience of land drainage work. Salary £1,000 p.a. to £1,250 by annual increments of £50, subject to satisfactory service. The appointment is subject to the Local Government Superannuation Act, 1937, and to medical examination. Applications stating (a) age, qualifications and experience and particulars of present employment; (b) when the applicant would be free to take up duty; (c) whether the applicant is related to any member of the Board and (d) the names and addresses of three referees, should reach the undersigned not later than Wednesday, the 11th November, 1950. Canvassing in any form will disqualify.

A.G. Stirk, Clerk of the Board. (Temporary Offices) Clark's Yard, High Row, DARLINGTON, Co.Durham. E5128

WHISTON RURAL DISTRICT COUNCIL, PRESCOT, LANCASHIRE

Tenders are invited for the supply of Valves, Machinery and Equipment for use in the new SEWAGE DISPOSAL WORKS to be constructed at RAINHILL.

The Contract will be divided into the following sections:-

Section A - Valves and Penstocks.

Section B - Power operated Mechanically Raked Screens, Conveyor Belt and Hand Raked Screen.

Section C - Rotary Sprinklers.

Section D - Pumping Equipment.

Contractors may tender for any or all of these sections.

Conditions of Contract, Specifications and Bills of Quantities, can be obtained on request from the offices of

the Consulting Engineers, MESSRS. HUSBAND & CO., at 388 GLOSSOP ROAD, SHEFFIELD 10. All enquiries should state the sections for which it is proposed to tender.

Sealed tenders must be delivered to the undersigned not later than noon on NOVEMBER 8th, 1950.

The Council does not bind itself to accept the lowest or any tender.

Dated this 11th day of October, 1950.

J. R. HENLEY.
Clerk of the Rural District Council,
Council Offices,
Whiston,
Prescot, Lancs. E5183.

KENT COUNTY COUNCIL

Applications are invited for the appointment in the Buildings Department of an ENGINEERING ASSISTANT (HEATING AND MECHANICAL) in A.P.T. Grade V (£520 - £570).

The post is superannuable and the successful candidate will be required to pass a medical examination.

Applicants must have passed the examinations required for Associate Membership of the Institution of Heating and Ventilating Engineers and have had at least five years' experience in the preparation or schemes, specifications and estimates for all classes of heating, hot and cold water supplies and ventilation work.

Applications, on forms obtainable from the County Architect, Springfield, Maidstone, must be delivered to him not later than 14 days after the appearance of this advertisement.

W. L. PLATTS.
Clerk of the County Council.
County Hall, Maidstone.
3rd October, 1950. E5113.

THE MINISTRY OF LABOUR & NATIONAL SERVICE

Applications are invited for an Unestablished Experimental Officer post in the MECHANICAL ENGINEERING RESEARCH ORGANISATION (Department of Scientific and Industrial Research), for work on the effect of high pressure on the properties of materials. The successful candidate will carry out work in connexion with the design of suitable equipment for producing high pressure and later will assist in the experimental research work connected with this investigation.

Candidates should be either mechanical engineers or physicists preferably with a degree or equivalent qualification and should have had experience in the design, construction and use of high pressure equipment, including special hydraulic presses. Research experience, preferably in the strength of materials and a working knowledge of electrical bridge circuits would be an advantage.

In the first instance, the officer appointed will be stationed at the National Physical Laboratory, Teddington, but will be transferred in 1951 to East Kilbride, near Glasgow, where housing accommodation is being made available.

The salary range for Experimental Officers is £510 - £660, Teddington, and £495 - £645, East Kilbride. The range for women is somewhat lower. Candidates should have been born on or before 1st August, 1922.

Write (quoting reference No.C.587/50A to Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, W.C.2. for application form which should be completed by 27th November 1950. E5340

THE CIVIL SERVICE COMMISSION

The Civil Service Commissioners give notice of a Supplementary Reconstruction Competition for pensionable appointments as DRAUGHTSMEN, (a) Architectural and Civil Engineering and (b) Mechanical and Electrical Engineering.

Applications will be accepted at any time up to 30th December, 1950 and selected candidates will be interviewed as soon as possible after the receipt of their Application Forms.

Candidates must have been born on or after 2nd August, 1905, and on or before 1st August, 1928, with extension for regular service in H.M.Forces. They must have obtained by 30th December, 1950 the Ordinary National Certificate or equivalent qualification; but for post of Architectural Draughtsman candidates without such qualification may be admitted exceptionally on evidence of training to an equivalent standard. Candidates must also have three years practical experience including one year in a Drawing Office.

Opportunities for promotion.

Regulations and application forms from Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1. quoting No. 3219. E5359.

HIS MAJESTY'S COLONIAL SERVICE
NORTH BORNEO

A vacancy exists for an ASSISTANT LOCOMOTIVE SUPERINTENDENT in North Borneo, to be the sole assistant to the existing Superintendent and to deputize for him when necessary. Appointment will be for 3 years on agreement, which may be renewable, on a salary scale (including expatriation allowance) of $475 to $1,000 per month (equivalent to £665 - £1,400 per annum). An additional cost of living allowance is payable varying from $85 per month (£119 per annum) for a single officer to a maximum of $135 (£189 per annum) for a married officer. The point of entry into the salary scale would be determined by qualifying experience and war service. At present there is no Income Tax in North Borneo. An outfit allowance of £60 is payable on first appointment to officers on a basic salary under $700 per month.

Free passages on first appointment and on satisfactory completion of his agreement will be provided for the officer, his wife, and up to 3 children (sons under 16); but an officer receiving a basic salary of over $600 per month will receive free passages only for children under the age of 10. Quarters will be provided at a rent not exceeding $40 per month. Leave will be granted at the rate of 4 days per month of resident service.

Candidates, preferably under 30 years of age, should hold the minimum qualification of a National Mechanical Engineering Certificate, should have served a mechanical engineering apprenticeship or pupilage with the British Railways, and have practical experience of drawing offices, running sheds, internal combustion and compression ignition engines.

For a form of application, write stating age, qualifications and experience to The Director of Recruitment, (Colonial Service), Colonial Office, Sactuary Buildings, Great Smith Street, S.W.1. Please mention this paper in any reply and quote reference No. 27333/37. E5324.

MIDDLESEX COUNTY COUNCIL
CHILDREN'S DEPT.

ENGINEERING AND METAL WORK INSTRUCTOR rqd. at St. Christopher's Approved School, Uxbridge Road, Hayes (accommodating 76 boys between 15/19). Should be recognised as Qualified Teachers by M/Education and practical engineers with good industrial experience. Subject to medical exam. Salary Burnham Scale plus 3 increments and London Award and payment of £104 p.a. for extraneous supervisory duties of not less than 15 hours a week. House in school grounds is in course of erection, accommodation charge to be decided. Application forms (stmpd. add. f'scap env.) from Children's Officer, 10 Gt. George St., Westminster, S.W.1. to be returned by 14th November (quoting H.698 Eng.) Canvassing disqualifies. E5357.

NOTTINGHAMSHIRE COUNTY COUNCIL
MANSFIELD TECHNICAL COLLEGE.

MINING & ENGINEERING EQUIPMENT

TENDERS are invited for the supply of Mining and Engineering Machinery and Equipment.

Forms of Tender and Specifications may be obtained from the DIVISIONAL EDUCATION OFFICER, EDUCATION OFFICE, MANSFIELD, NOTTS. Tenders enclosed in envelopes to be supplied should be returned to the Clerk of the County Council within 14 days of the appearance of this advertisement.

K. TWEEDALE MEABY,
Clerk of the County Council.

Clerk of the County Council.
Shire Hall,
Nottingham. E5358.

METROPOLITAN BOROUGH OF WANDSWORTH

MORTAR PAN MIXER

Tenders are invited for the supply and delivery of a Mortar Pan Mixer.

Tender documents, which can be obtained on application to the Borough Engineer and Surveyor at the undermentioned address, must be returned to me not later than 12 noon on Wednesday 15th November, 1950.

R. H. JERMAN,
Town Clerk.
Municipal Buildings,
Wandsworth, S.W.18.
October, 1950. E5323.

BRITISH ELECTRICITY AUTHORITY
SECOND ASSISTANT ENGINEER (MECHANICAL)
GENERATION CONSTRUCTION BRANCH
PRODUCTION, INSPECTION AND TEST SECTION
LEEDS REGIONAL OFFICE

Applications are invited for an appointment as SECOND ASSISTANT ENGINEER (MECHANICAL) in the Production, Inspection and Test Section of the Generation Construction Branch at the Regional Office, Leeds.

Applicants should have educational and engineering qualifications up to the standard required for Associate Membership of the Institution of Mechanical Engineers.

Practical experience in engineering works producing Power Station plant, together with a knowledge of Power Station operation, would be an advantage.

The commencing salary for the appointment, which is superannuable, will be within Grade 3 of the N.J.B. Agreement, £719 per annum to £969 per annum, according to qualifications and experience, rising ultimately to a maximum of £1,070 per annum.

Applications stating age and present salary, and giving full details of qualifications and experience should be addressed to D. MOFFAT, Director of Establishments, British Electricity Authority, British Electricity House, Great Portland Street, London, W.1., so as to be received not later than 13th November 1950.

Please quote reference AE:112. E5306.

MELBOURNE HARBOR TRUST COMMISSIONERS

Applications closing Friday 24th November 1950 are invited for the undermentioned positions:-

PRINCIPAL OFFICE ENGINEER at a salary of £1500 per annum.

PLANNING ENGINEER at a salary of £1200 per annum.

SENIOR DESIGNING ENGINEERS at a salary of £1100 per annum.

Salaries include current cost of living adjustment. If housing is not otherwise available the Commissioners will provide residences under the rate of rental for the type of accommodation provided.

Conditions of appointment may be obtained from A.E. Turner & John Coates & Co. Victoria House, Melbourne Place, Strand, London, W.C.2.

A. C. COOK
E5308 SECRETARY

FIRE SALVAGE ASSOCIATION OF LIVERPOOL LTD. (LIVERPOOL SALVAGE CORPS)

The Committee invite applications, not later than 31st December, for the post of THIRD OFFICER OF THE CORPS, from mechanical engineers with academic qualifications and some administrative training. Age not exceeding 35. Salary between £600 and £700 (with unfurnished quarters and uniform) according to qualifications. Applicants must have served in H.M. Forces and the person appointed will be required to pass a strict medical examination and must not need to wear glasses. The post is pensionable, though no superannuation contributions are paid by the ataff. Form of application may be obtained from the Chief Officer, Liverpool Salvage Corps, 26 Johnson Street, Liverpool 3. Canvassing will disqualify, and the appointment will be probationary for twelve months. E5349.

CITY OF BIRMINGHAM MUSEUM & ART GALLERY
DEPARTMENT OF SCIENCE AND INDUSTRY

Applications are invited for the post of ENGINEERING ASSISTANT (HISTORICAL RESEARCH) in the Department of Science and Industry.

The salary will be within the scale A.P.T. VII (£635 - £710).

The person appointed will be required to make an historical survey of prime movers, machine tools, and hand processes. He will also be required to prepare leaflets and explanatory matter relating to the work of the Museum and to search for specimens for exhibition.

The duties will also include the delivery of lectures to the public on items of general interest relating to that part of the Museum devoted to Industry.

Candidates should possess a university degree in electrical or mechanical engineering. A sound knowledge of Birmingham Industrial history and an engineering apprenticeship or other experience in industry is desirable.

The post will be subject to the Local Government Superannuation Act and the General Conditions of the National Joint Council for Local Authorities, Administrative Services, etc. as adopted by the City Council. The successful candidate will be required to pass a medical examination.

Applications should be made on the approved form, a copy of which may be obtained from the undersigned.

Completed forms of application must be received by me not later than Monday, 20th November, 1950.

TRENCHARD COX.
Director.

City Museum and Art Gallery,
Birmingham 3,
12th October, 1950. E5345.

DUNDEE INSTITUTE OF ART & TECHNOLOGY
DUNDEE TECHNICAL COLLEGE

The Governors of Dundee Institute of Art and Technology invite applications for the post of HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT: Salary Scale £950 by £25 to £1,100. Placing on this scale will be given for previous experience in a similar position. There is an additional payment of £50 per annum for responsibility in connection with the College Heating plant.

Further particulars, conditions of appointment and Application Forms can be obtained from the Clerk and Treasurer, 40 Bell Street, Dundee.
18th October 1950. E5314

LEE CONSERVANCY CATCHMENT BOARD
ASSISTANT ENGINEER

Applications are invited for the appointment of an ASSISTANT ENGINEER at a salary of £555 x 20 - £615 per annum plus London Weighting (A.P.T. Division V(a) + £5).

The appointment is in connection with investigation, design and construction work for a number of river flow gauging stations, and previous experience in this field of engineering is desirable. This post is not at present on the Board's permanent establishment, but it may become established at a later date.

Travelling and subsistence allowances will be payable on the scale from time to time in force for Local Government Officers, and the successful applicant will be required to provide his own car.

The appointment will be subject to the National Scheme of Conditions of Service, and to one month's notice on either side, and the successful applicant may be required to pass a medical examination.

Applicants should state whether they would wish to be specified as contributory employees for the purposes of the Local Government Superannuation Act, 1937, and if so give particulars of previous contributory and non-contributory service.

Applications stating age, qualifications, experience etc., accompanied by copies of three testimonials, and endorsed "Assistant Engineer (E)", should reach N. Medrington Esq., A.M.I.C.E., Engineer to the Board, The Grange, Cheshunt, Herts, not later than first post on Monday, 20th November 1950.

J. L. SPILLER
Clerk of the Board.

Head Office of the Board,
Brettenham House,
Lancaster Place,
Strand, London, W.C.2. E5351.

BRITISH ELECTRICITY AUTHORITY
NORTH EASTERN DIVISION

APPOINTMENT OF A THIRD ASSISTANT ENGINEER (STATISTICAL)

Applications are invited from suitably qualified engineers for the appointment of a Third Assistant Engineer to act as Technical Assistant to the Statistical Officer at Divisional Headquarters, Newcastle upon Tyne.

The duties of the successful candidate will include the collation and interpretation of statistical data relating to the Generation and Transmission of Electricity, estimation of cost and technical data, estimation of demands and analysis of schieved figures.

Applicants should preferably possess an engineering degree or equivalent qualifications and a knowledge of economics and statistics would be an advantage. It is also desirable that applicants should have had operational experience in a Power Station.

The salary for this appointment will be in accordance with Grade 5 Schedule C of the National Joint Board Agreement (£570 - £753 per annum) and will commence at a point commensurate with qualifications and experience.

Superannuation will be in accordance with the British Electricity Authority and Area Boards Superannuation Scheme.

Forms of Application may be obtained from the Divisional Secretary, (Establishments), British Electricity Authority, North Eastern Division, Carliol House, Newcastle upon Tyne 1, to whom completed forms should be returned to arrive not later than 10th Novembet, 1950. E5302.

THE ADMIRALTY

Admiralty invites applications for unestablished appointments as TECHNICAL AUTHOR IN VARIOUS NAVAL ESTABLISHMENTS. The duties are to prepare Technical Publications and Handbooks on electronic equipment used in H.M.Ships.

The posts will be graded in one or other of the ranges: £625 x £25 - £750 or £500 x £20 - £625 according to qualifications and experience. Rates outside London will be a little lower.

Candidates should have had experience in the production, maintenance and/or operation of radio and radar equipment or electronic control systems. In addition, they should either have completed an engineering apprenticeship or equivalent training and possess technical knowledge to the standard of Higher or Ordinary National Certificate, or alternatively, have had extensive experience in one or other of the appropriate technical and specialist branches of the Royal Navy. Preference will be given to those who have had previous experience in technical writing.

Write quoting D. 49/50 - A. to Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, W.C.2. for application form which must be returned completed by 14 days after the appearance of this advertisement. E5328.

WAR DEPARTMENT

Applications are invited for the following vacancy (a second vacancy is a possibility in the near future) in the Fortification and Works Directorate, at Chessington, Surrey:-

ASSISTANT CIVIL ENGINEER. Must be a Corporate Member of Institution of Civil or Structural Engineers, have specialised experience in design and construction of steel-framed buildings and must be fully conversant with B.S.449 (1948) and British Standard Codes of Practice for steelwork design. A knowledge of reinforced concrete construction would be an advantage.

Applicants should be under 50 years of age. Salary for the post is on the range £448 - £720 per annum. Starting salary will be fixed according to age, qualifications and experience. Annual increases are payable subject to satisfactory service.

The post is temporary but has long-term possibilities and Open Competitions are held periodically to fill established posts.

The work is varied and interesting and good canteen facilities exist.

Apply, in writing only, stating age, nationality and full details of qualifications and experience to the War Office (C.5 (A)), Room 504, Hotel Victoria, Northumberland Avenue, W.C.2. E5329.

WEST KENT MAIN SEWERAGE BOARD
APPOINTMENT OF ENGINEERING ASSISTANTS

Applications are invited for the following appointments:-

(a) Chief Engineering Assistant - Grade X, A.P. & T. Division, £880 x £50 to £1,030 p.a.

(b) A Senior Engineering Assistant - Grade VIII, A.P. & T. Division, £715 x £25 to £790 p.a.

(c) Two Engineering Assistants-Grade V, A.P. & T. Division, £550 x £15 x £20 to £600 p.a.

(d) A Junior Engineering Assistant - Grade I, A.P. & T. Division, £390 x £15 to £435 p.a. plus London Weighting.

Applicants for appointments (a), (b) and (c) must be Chartered Civil Engineers.

Applicants for appointment (a) must have extensive experience in the design, construction and management of large sewage purification works and sewerage systems.

Applicants for appointment (d) must have completed articles or works training and have at least one year's experience of general engineering drawing office practice and be pursuing a recognised course of part-time study in CivilEngineering.

The appointments will be subject to the provisions of the Local Government Superannuation Act, 1937, and the candidates selected will be required to pass a medical examination by theBoard's medical adviser and if appointed to devote their whole time to the duties of the office.

Applications, in candidates' own handwriting, endorsed "Engineering Assistants", giving details of age, training, qualifications, experience and present and past appointments, together with the names of three referees must be delivered to the undersigned not later than 16th November 1950. Canvassing will disqualify.

EDMUND POCKNELL, Secretary
"Barnfield", 20 Blyth Road, Bromley, Kent. E5321

THE UNIVERSITY COLLEGE & MEDICAL SCHOOL OF THE WEST INDIES

Applications are invited for the position of an ASSISTANT CLERK-OF-WORKS to supervise the erection in Jamaica of the first stage of the University College and Medical School of the West Indies. Applicants must have had experience of large building contracts and must be capable of using a dumpy level. A knowledge of mechanical and electrical services of the type normally installed in hospitals would be an advantage. The appointment will start early in 1951 and be for about 2 years. Age between 30 and 50. Salary up to £900 per annum according to qualifications. Passage allowance will be paid at start and end of appointment. Applications in writing, giving full particulars including qualifications, experience and age must be addressed to Norman & Dewbarn, 5 Gower Street, London, W.C.1. and must be received not later than 27th November. E3651.

CROWN AGENTS FOR THE COLONIES

ASSISTANT INSPECTING ENGINEER required for duties in the United Kingdom. The Inspectorate deals with a wide range of engineering products and vacancies occur for Engineers with the following qualifications:-

M/N/25880(3B). (1) Internal Combustion Candidates (aged 25 to 35 years) should have served an apprenticeship with a Firm manufacturing the larger sizes of Internal Combustion Engines and be thoroughly familiar with their construction, operation and testing, with subsequent experience on the manufacturing and/or technical side. A knowledge and some experience of electrical plant would be an advantage.

M/N/25881(3B). (2) Electrical. Candidates (aged 25 to 35 years) should have served an apprenticeship with a Firm manufacturing heavy electrical plant including Motors, Generators, Transformers and Switchgear and should have had subsequent experience on the manufacturing and/or technical side. A knowledge and some experience of internal combustion engines would be an advantage.

In both cases candidates having experience of diesel-electric traction would be given preference. Candidates should preferably hold a University Degree and/or be Corporate Members of one of the major Engineering Institutions or be in a position to obtain this membership within 2 years.

The salary scale is £475 x £25 to £650. The £475 minimum is linked to entry age at 25 with an addition of £25 for each year above that age up to £600. Extra duty allowance of 9% of annual salary is also payable at present. Travelling expenses and/or car mileage allowance with appropriate subsistence allowances are paid.

Engagement will be on unestablished terms with a prospect after satisfactory service and as vacancies occur, of appointment to established and pensionable staff and promotion to a higher grade.

Apply at once by letter, stating age, full names in block letters and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4 Millbank, London S.W.1. quoting M/N/25880(3B) for 1. and M/N/25881(3B) for 2. on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. E5325

THE TEES VALLEY WATER BOARD
DEVELOPMENT OF THE UNDERTAKING

In connection with certain works for the development of the water undertaking which the Board proposes to carry out, Conditions of Contract, Specifications, Bills of Quantities

and Drawings have been prepared. TENDERS are invited from Contractors thoroughly experienced in the several classes of work scheduled below.

A RAPID GRAVITY FILTRATION PLANT incorporating two Pumping Stations and Ancillary Work at BROKEN SCAR PUMPING STATION, DARLINGTON.

Contract No.	Work of Item
No.24	(1) The High Lift Pumping Station and Filtration Works - Constructional Work in Piled Foundations and Reinforced Concrete Structures, etc. (2) The Low Lift Pumping Station - Constructional Work in Cofferdam, Piled Foundations and Reinforced Concrete Structures, etc. (3) The Construction of Roads and Drainage at the High Lift Pumping Station and Filtration Works. (The work covered by Specifications 1, 2 and 3 will be let as one contract and not as separate items). Deposit £10.10.0.
No.25	The Provision, Erection and Setting to work of Electrically Driven Pumping Plant at the Low Lift and High Lift Pumping Stations. Deposit £5.5.0.
No.26	The Provision and Installation of Venturi Meters, Level, Pressure and Weir Recorders. Deposit £3.3.0.
No.27	The Provision, Erection and Setting to work of Electrically Driven Self-Cleaning Band Screens at the Low Lift Pumping Station. Deposit £3.3.0.

Contractors who are desirous of tendering for any of the above-mentioned works or items should apply in writing to T.S.R. Winter Esq., M.I.C.E., Engineer and General Manager, The Tees Valley Water Board, Corporation Road, Middlesborough, indicating those items in which they are interested and enclosing the appropriate amount or amounts of deposit. Cheques to be made payable to "The Tees Valley Water Board". The deposit/s will be returnable upon the submission of a bona-fide tender.

Tenders in plain sealed envelopes bearing no means of identification, endorsed in accordance with the instructions contained in the documents and addressed to "The Chairman of the Board" at the undermentioned address, shall be received not later than 10 A.M. on Monday, the 29th January 1951. The Board does not bind itself to accept the lowest or any tender.

E. A. MORRIS
Clerk of the Board.

Water Board Offices,
Corporation Road,
Middlesborough.
October, 1950. E5337.

NORTH EASTERN GAS BOARD
Industrial Gas - Research and Development Section

Applications are invited by the 20th November, 1950, for the position of TECHNICAL ASSISTANT in the above section, at Valley Road, Bradford, from candidates possessing a degree in Mechanical Engineering. Salary £450 to £530 per annum. Further particulars are obtainable from the Chief Commercial Officer, North Eastern Gas Board, Bridge Street, Leeds 2

J. C. GARDNER,
Secretary.

Bridge Street,
Leeds, 2.
24th October, 1950. E5357

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION
RESIDENT ENGINEER

Applications are invited for the appointment of Resident Engineer to the Trinidad & Tobago Electricity Commission.

The Commission has under construction a new power station at Pensl, consisting initially of two 5,000 kVA. turbo-alternator sets with two water tube boilers and ancillary equipment, which will be interconnected through a 66 kV. transmission line with the Port of Spain power station of 19,900 kVA. capacity. A Diesel engine power station is to be constructed on the island of Tobago.

The Engineer appointed will be responsible for the supervision of construction of the complete power station plant and buildings, including water tube boilers, turbo-alternators, pipework, switchgear and auxiliary equipment, together with machine and building foundations and superstructure.

Applicants must be not more than 40 years of age and be fully qualified engineers with considerable experience in the work outlined above.

The salary of the appointment is in the scale $6,480 - $240 - $6,960 per annum (£1 = $4.80 B.W.I.) equivalent to £1,350 - £50 - £1,450 p.a.), subject to satisfactory service.

Furnished quarters at moderate rentals or a rent allowance in lieu are provided under the Commission's Regulations.

Free passages are provided for the officer and family not exceeding four persons.

An outfit allowance of $288 (£60) will be granted on first appointment.

The appointment is subject to an agreement for a period of three years and medical examination by the Commission's medical adviser.

Applications, endorsed "Resident Engineer, Trinidad", stating age, marital status, family, nationality, general and technical education, qualifications and experience, and full particulars of appointments held, with references, to be submitted to the undersigned within 21 days from the date of this advertisement.

PREECE CARDEW & RIDER,
8 & 10, Queen Anne's Gate,
Westminster, S. W. 1.
E5355

SITUATIONS OPEN

A company of international repute have a vacancy for a Communications Specialist with experience in the planning of H.F. and V.H.F. Radio networks in either the civil or aeronautical spheres. The post is primarily a sales one, but some technical experience is essential. The applicant should have access to Government and similar authorities likely to be interested in such equipment in both this country and overseas. This is a senior post with a commensurate salary. Write in confidence, full details of experience, age and salary required. Our staff have been informed of this vacancy. Box No. E5354, The Engineer Office. A.

A deputy to the Chief Engineer is required by a firm of Civil Engineers & Contractors. This is a permanent appointment offering excellent prospects. Applicants, who should be 35 to 40 years of age, must be well qualified and have had practical experience of contract work. Write Box P.T.R. c/o 95, Bishopsgate, London, E. C. 2. E5320 A.

A Light Engineering Company in South Wales requires a CHIEF DRAUGHTSMAN. Applicants should be men between 30-45 years of age, possessing a complete knowledge of Press and Jig and Fixture Design. Salary approx. £650, according to age and qualifications. Housing accommodation will be made available. Address, E5175, The Engineer Office. A.

A Light Engineering Company in South Wales requires a DEVELOPMENT ENGINEER. Applicants should be men between 25 - 45 years of age and possess a good all round knowledge of Engineering Process Layout, Tool Design and Mechnical Handling. Salary approx. £600, according to age and qualifications. Housing accommodation made available. Address, E5176, The Engineer Office. A.

A Light Engineering Company in South Wales requires a TOOL DESIGN CHECKER. Applicants should be men between 30-45 years of age and possess a complete knowledge of Press Tool and Jig and Fixture Designs. Salary approx. £600, according to age and qualifications. Housing accommodation made available. Address, E5177, The Engineer Office. A.

A Mechanical Engineer is required as Sales Technical Adviser for service in India and Pakistan on the permanent staff of major Oil Company. Aged 25 to 33 years. Four year contracts with 6 months leave period out of India/Pakistan. Candidates must be Associate Members of the Institute of Mechanical Engineers or possess an engineering degree with at least 2 years workshop training. In addition to above candidates must have 3 to 4 years industrial engineering experience. Starting salary £800/£1000 per annum according to qualifications and experience plus liberal cost of living and other allowances together with retirement benefits. Outfit allowance £75. Selected candidates will be given 2 to 3 months course in U.K. in fuel oil combustion and application of lubricants. Apply in writing stating age, whether married or single and giving full particulars of education, qualifications and experience to Box Z.Y. 398, Deacon's Advertising, 36 Leadenhall Street, E.C.3. E5307 A.

A position of permanency with pension rights on the Switchgear Drawing Office staff of the English Electric Company at Stafford is now available to SENIOR DRAUGHTSMEN with experience

of station layout for Outdoor Switching Stations. Experienced layout draughtsmen are asked to send particulars of their experience quoting ref. 151 to Central Personnel Services English Electric Co. Ltd., 24-30, Gillingham Street, London, S.W.1. E5064 A.

A training in Draughtsmanship can now be given to several young men aged 20-23 who have had at least three years workshop experience and who have obtained Ordinary or Higher National Certificates in Mechanical Engineering. These vacancies exist at the Rugby Works of English Electric Company, and preference will be given to applicants who have some experience of steam, gas or water turbines, or diesel engines. Apply giving full particulars quoting ref. 152 to Central Personnel Services, English Electric Co. Ltd., 24-30, Gillingham Street, London, S. W. 1. E5065 A.

A vacancy exists in the Research Department of Vickers-Armstrong Ltd., Barrow-in-Furness, for a young graduate in Physics or Engineering with experience of industrial instruments with particular reference to the design, maintenance and operation of Electronic Instruments. Particulars should be addressed to the Senior Personnel Officer, stating qualifications, age, experience and salary required. E5057 A.

A vacancy has arisen for a Chief Process Layout Engineer in a South Wales light engineering factory. Applicants must have served a recognised apprenticeship in mechanical engineering, have been educated up to Ordinary National Certificate standard, and have had at least five years experience in layout work. Housing accommodation will be made available. Salary in accordance with age and qualifications. Write Box E5296, The Engineer Office. A.

A vacancy has occurred on the parmanent staff of an industrial firm of high standing for an Executive with first class experience of production planning. The appointment, which is pensionable, calls for qualities of leadership, energy and ambition above the average. The prospects are outstandingly good. Remuneration up to £3,000 a year may be earned after four years service. The essential qualifications are University Degree, good works training and experience, age not over 35 years. Please send full particulars of qualifications in confidence to Box No. E5305, The Engineer Office. A.

A well known firm of Engineers has a vacancy in their Boiler Dept. for a Contracts Engineer. Only applicants with experience of large modern water tube boiler plant design will be considered. Write giving full details of experience and salary required to Box No. E3650, The Engineer Office. A.

ADMINISTRATIVE opportunity - ENGINEER 26-30, experience in light engineering required to undertake training leading to responsible Costing position in East Anglian factory. Write, E3537, The Engineer Office. A.

AN ESTIMATING ENGINEER of considerable experience and ability is required by a leading firm of chemical engineers to take charge of their estimating department. Applicants should be fully trained and qualified engineers with a wide knowledge of the construction, manufacture and cost of large scale chemical, process and petroleum plants and equipment and conversant with modern estimating methods. Age 40-50. London Area. Address, E5050, The Engineer Office. A.

An excellent opportunity arises in a progressive company in Edinburgh for a Mechanical Engineer, age 25-30 with a first class degree, to act as an assistant to the chief engineer. Applicants must have served a recognised engineering apprenticeship and have had subsequent industrial experience. Write giving full details of education, experience and salary required to Box No. 652 Keith & Co., Advertising Agents, Edinburgh. E344. A.

An old established Oversess firm requires an Engineer, not more than 35 years of age, fully qualified to handle important Mechanical and Electrical Agencies. Applicants must have general commercial and estimating experience, be able to undertake representation work and to conduct all technical correspondence. Service contract provides for free passages and full pay leave. Excellent prospects. Reply with full particulars of qualifications and past experience to Box "F.G.T." c/o 95 Bishopsgate, London, E.C.2. E5345 A.

Applications are invited from University Graduates aged up to 30 years with an Engineering degree, for a vacancy as a JUNIOR ASSISTANT to the MANAGER of a branch works of a large manufacturing group. Applicants to be prepared to handle detail technical queries and correspondence, also to be suitable for training to take over some administrative duties. Persons resident in the West Riding area of Yorkshire preferred. Write, stating details of schooling and University education, details of technical and practical experience and of positions held. Address, E3543, The Engineer Office. A.

Applications are invited by the British Electric Co. Ltd., for ENGINEERS having wide experience in the preparation of comprehensive and specialised schemes of machine control. Applicants must be of Higher National Certificate standard and capable of preparing schemes in detail. Apply, quoting reference 806 to Central Personnel Services, English Electric Co.Ltd., 24-30, Gillingham Street, London, S. W. 1. E5090 A.

Applications are invited by the English Electric Co.Ltd., Stafford, from young ENGINEERS of Graduate or Higher National Certificate standard with experience in the preparation of control gear wiring diagrams, for training as control gear engineers on specialised schemes. Selected applicants will, where necessary, be given a short course of training and will receive full pay during this period. The positions are permanent and progressive and afford excellent opportunities. Apply quoting ref. 805 to Central Personnel Services, English Electric Co. Ltd., 24-30, Gillingham Street, London, S.W.1. E5091 A.

Assistant Civil Engineer for work in Malaya or Borneo is required by a British firm of Civil Engineering Contractors. Applicants must hold University Degree, A.M.I.C.E. or Diploma of Royal Technical College, Copenhagen and should be experienced in design and construction of R.C. structures, particularly in construction of Cement Works. Write for interview to Box I.P.G. c/o 95 Bishopsgate, E.C.2. E5344 A.

Assistant Electrical Engineer between 25 and 30 years of age required for Consulting Engineers' London Office, with experience in the design and manufacture of medium size generating, transforming and converting plant, transmission lines and distribution systems, the electrical driving of workshop machines and engineering plant, and electric traction.
Applicants must have passed the qualifying examinations for Associate Membership of the Institution of Electrical Engineers.
Salary according to age, qualifications and experience.
Apply in writing to Box 3737 c/o Charles Barker & Sons Ltd., 31 Budge Row, London, E.C.4. E5326 A.

Assistant Engineer wanted at once by Consulting Engineers for their London Office. Age 25 to 30 years. Should have had good general training as a mechanical engineer and experience of Diesel engines would be an advantage. Preference will be given to applicants who have passed the examination for Corporate Membership of the Institution of Mechanical Engineers. Apply in writing to Box No. 3736 c/o Charles Barker & Sons Ltd., 31 Budge Row, London. E.C.4. E5327 A.

Assistant Engineer required by Gold Mining Company operating in the Gold Coast, age not over 30, membership of one of the recognised Institutions essential, some experience with mining company would be advantageous. Candidates should be thoroughly conversant with I.C. prime movers, A.C.H.T. generation and modern mining and treatment plant equipment. Initial salary not less than £1,000 per annum. Applicants should give full details of their career, whether married or single and if physically fit. Wife would be unable to accompany husband for the first tour. Period of tour 15 months followed by 3 months leave on full pay. A non-contributory pension scheme is in operation. Laundry, light and medical attention free. Simply furnished quarters are provided. Write to Box 7456, Whites, Ltd., 72/78, Fleet St. London, E.C.4. E5351 A.

Assistant Estimating Engineer experienced in pressure vessel work and allied equipment and machinery for the Chemical and Petroleum Industries required by firm of Plant Manufacturers London area. Excellent opportunity for a man of ability and sound practical background. Write giving full details of experience and salary required. Address, E5049, The Engineer Office. A.

Boiler Installation Engineer with sound experience of Individual Boiler Plants and capable of supervising the Installation starting up and Testing of Shell Boiler Contracts throughout The British Isles. State age, experience and salary required to Box E3513, The Engineer Office. A.

Brick Superintendent and Assistant Brick Superintendent required for large Iron and Steel Works in India to take full charge of the lining and relining of modern coking plant, blast furnaces, fixed and tilting open hearth furnaces and reheating furnaces. Apply, in writing, giving full details of experience, to Box No. 628, c/o Abbotts, Eastcheap, London, E. C. 3. E3528 A.

BRITISH RAILWAYS (Western Region) require for London Office DESIGNERS for reinforced concrete bridges and structures. Salary up to £630 according to age and experience. Knowledge of pre-stressed concrete desirable. Permanency and prospects of advancement for right man. Application with age, details of previous experience. Address, E5157, The Engineer Office. A.

Buyer of engineering supplies, including raw materials, for Birmingham factory of about 300 workers engaged in light presswork and machining welded fabrication etc., must have good contacts with steel manufacturers and stockists; give details and salary to Box No. E5349, The Engineer Office. A.

Chemical Engineer required for a processing factory in the North West area. Applicants should have a good University degree, at least seven years' practical experience and should be from 33 to 45 years of age. A salary of not less than £2,000 per annum will be paid to the successful applicant who, it is intended, should ultimately be in complete control of the plant. Please reply to KQNC, Box No. E3661, The Engineer Office. A.

Chief Buyer- A large company located in the London area engaged in light engineering desires to appoint an experienced buyer to control the purchasing for its main and branch factories. The man required must be of broad vision, have a well defined sense of Economics; the ability to delegate work to assistants and be capable of creating and operating an efficient buying organisation. To the right man the remuneration will be generous and the position one of high status in the company. Applicants must give full particulars for the personal consideration of the Managing Director and all applications will be treated in the strictest confidence. E5353 A. The Engineer Office.

Chief Chemical Engineer required with Chemical knowledge and experience in design, operation and selling of Chemical Plant used in the Chemical, Colliery and Paper Making Industries. State. age, experience, salary required to Box E5311, The Engineer Office. A.

Chief Draughtsman required to take charge of small Drawing Office in light engineering works. Must be fully experienced and qualified technically to degree standard; mainly mechanical engineering but sound electrical knowledge essential. South London district. Box No. 3674, The Engineer Office. A.

Chief Draughtsman required by Midland Manufacturers. All replies treated in strict confidence. Applications should state full details of qualifications, experience, and salary required. Address, E3514, The Engineer Office. A.

Chief Draughtsman required, experienced Press Die-Casting Moulds and Multi-Progression Press Tools. Small drawing office, Willesden area. Interesting and varied work. Salary region £600 p.a. Address, E3565, The Engineer Office. A.

Chief Engineer required to undertake responsibility for the maintenance of plant and machinery in a large modern Biscuit factory. Age about 35 yrs. University degree desirable and good staff control essential. Salary in accordance with qualifications and experience. Pension scheme. Write in confidence giving full particulars to the Personnel Manager, Jacob & Company, Aintree Biscuit Factory, Liverpool, 9. E5299 A.

Civil Engineering Assistant required, preferably with dock, harbour or river experience, for design work in Consulting Engineer's Office, Westminster. Knowledge of reinforced concrete desirable. Write full particulars and salary required. Box E3669. The Engineer Office. A.

Civil Engineering Contractors in Liverpool (Kirkby) require STRUCTURAL STEEL DRAUGHTSMEN for the design of light frame structures. Age 22-30 years. Salary according to age and experience. Applications in writing, giving details of age and experience etc. Address, E5182, The Engineer Office. A.

Civil Engineering Surveyor- Assistant required by Consulting Engineers for Site Work. Must be prepared to work abroad for short terms. Experience in the routing of water mains and general town planning desirable. Applications stating technical qualifications and experience should be addressed - The Secretary, Ewbank & Partners, 15, Grosvenor Place, S.W.1. E5356. A.

Civil Engineers with experience of sewerage or sewage disposal are required by Consulting Engineers in Westminster, salaries up to £1,000 per annum according to experience. Replies to Box No. E5072, The Engineer Office. A.

Designer and Senior Draughtsman wanted for engineering works Enfield district. Workshop experience essential knowledge paper converting and packaging machinery desirable. Box No. E3653. The Engineer Office. A.

Design Draughtsman (Senior). First class men wanted for light mechanical work on Aircraft. Five day week. Pension & Life Assurance Scheme. Apply Employment Manager, Vickers-Armstrongs Ltd., Weybridge. E5125 A.

Designer draughtsmen required by large centrifugal pump manufacturers in North East. General engineering experience essential; knowledge of pump work desirable. Write giving details of training, experience and salary required to: Chief Engineer, Sigmund Pumps Ltd., Team Valley, Gateshead. E5347 A.

Designer/Draughtsman required for interesting work in plant developing and design. Experience in steel mill plant advantageous. Pension Scheme and 5 day week. Good prospects. Age experience and salary required, experience, etc., to Personnel Manager, T.I.G.S. Ltd., Rocky Lane, Birmingham 6. E5151 A

Assistant General Manager required for moderate-sized but rapidly expanding London Engineering Company, specialists in hydraulic equipment and centralised lubrication. Post carries responsibility for control of production (mainly sub-contracted) and its co-ordination with Sales and Design Depts. Applicants must be competent mechanical engineers with previous experience at this level. Post offers prospects to man of initiative, able to get results. Commencing salary £850. State full details of training, experience and age, to Box 318, c/o Geo. Murray (Advertising) Ltd., 184, Strand, London, W. C. 2. E5110 A.

DESIGNER with experience of both passenger and commercial vehicles urgently required by a Midland Commercial Vehicle Manufacturer. Apply giving details of training, both practical and technical, and experience to Address, E3545, The Engineer Office. A.

DRAUGHTSMAN 21-24 required for chemical engineers in S. E. London. Some knowledge of tank work and general engineering. State full particulars to Box No. E3656. The Engineer Office A.

DRAUGHTSMEN & ESTIMATORS required for an interesting variety of Chemical Plant work. Midland area. Apply Box No. E5333. The Engineer Office. A.

DRAUGHTSMAN for Old Established Dudley Engineering firm; experienced in Constructional Engineering and Pressure Vessel design in Stainless Steel, etc. Canteen facilities. State age, qualifications and salary required. Address, E3533, The Engineer Office. A.

DRAUGHTSMAN, Junior, required by London Rubber Manufacturers preferably with knowledge of mould design for rubber and plastics. Matriculation or equivalent standard essential. Reply in first instance to Box E3654 The Engineer Office. A.

DRAUGHTSMEN required by old established Derby firm of engineers with modern Drawing Office. Preferably those who have experience in mechanical handling plant are asked to apply. Successful applicants will participate in an attractive superannuation and bonus scheme. Please submit full details of experience and salary required to Box No. E3663, The Engineer Office. A.

DRAUGHTSMAN required by Firm of Heating, Ventilating and Combustion Engineers in Westminster. Applicants should have experience in design of heating systems, boiler house plants and airconditioning schemes. Please write to Box No. E3667, The Engineer Office. A.

DRAUGHTSMAN required in Civil Engineer's Office; knowledge of steel and/or concrete design. Salary according to experience and ability. Position is pensionable and permanent. Apply in first instant to J. L. Eve Construction Co.Ltd., 53, Plough Lane, Wimbledon, S. W. 19. E3563 A.

DRAUGHTSMAN required for work on the design of plant and ancillary equipment, including ovens and conveyors used in the production of arc welding electrodes. Applicants should have some experience of hydraulic machinery and good general mechanical knowledge. Technical qualifications, O.N.C. minimum, age about 24 years. 5-day week. Apply, Address, E3564, The Engineer Office. A.

DRAUGHTSMAN required with ten to twenty years experience in drafting and design with preference for experience in general mechanical engineering and machine tool work. Automobile electrical or jig and tool experience also an advantage. Applicant with Higher National Certificate and having served an apprenticeship with shop experience will be preferred. The position offers permanency with considerable variety of work, good working conditions, five day week and opportunities for advancement to capable and energetic applicants. Apply in writing giving age, full experience, qualifications and salary required to Personnel Manager, Fort Dunlop, Erdington, Birmingham, 24. E5046 A.

DRAUGHTSMEN. Seniors, over 25 years, for Westminster Office, experience in Mechanical Handling Plants or Cranes. Salary according to experience and ability. Pension Scheme. 5 day week. State age, experience and salary required to Box No. E3648, The Engineer Office. A.

DRAUGHTSMEN urgently required for Research Department, Vickers-Armstrong Limited, Barrow-in-Furness, with good general experience in Mechanical Engineering, preferably Marine Engineering. Good salaries paid to suitable men. Apply, giving full particulars of experience to Senior Personnel Officer, King's Gate. E5036. A.

DRAUGHTSMEN. Vacancies exist in the Billingham Division of Imperial Chemical Industries Limited for experienced Mechanical, Electrical, Civil, and Structural Draughtsmen. Applicants should have had shop experience and have as a minimum qualification the Higher National Certificate in Mechanical Engineering or its equivalent. Application Forms can be obtained from the Staff Manager, I.C.I. Limited, Billingham Division, Billingham, Co. Durham. E5298. A.

DRAUGHTSMEN with experience of Structural and Steel Fabrication Details, preference given to men with some experience on Water Tube Boiler Work, but this is not essential. Required by firm on North-east Coast. Apply stating age, experience and salary required to Box E3657, The Engineer Office. A.

DRAUGHTSMAN. Senior and Junior required. Experienced in Cranes, Hoists and Winches, power and hand, both structural and mechanical. Write briefly in first instance giving age and experience. R. C. Gibbins & Co. Ltd., Berkley Street, Birmingham, 1. E5172. A.

ELECTRICAL ENGINEER having experience in E.H.T. and L.T. distribution layouts required for Works Engineers department of large industrial concern on outskirts of Birmingham. Higher National Certificate desirable. Salary according to qualifications and experience. Address, E5148, The Engineer Office. A.

ELECTRICAL ENGINEER - SENIOR. A progressive and expanding company in the London area desires to appoint a senior Electrical Engineer at executive level. The appointment will involve a responsibility for design and development of electrical apparatus, mainly small transformers, and a wide experience of design of all types is essential. The individual appointed will also be required to supervise all experimental work. A first class degree in electrical engineering and/or membership of the I.E.E. is an essential requirement, coupled with several years practical design and manufacturing experience with one of the reputable electrical manufacturing companies. This appointment is an important one and will carry substantial remuneration to a man with the requisite experience and ability. The lower age limit will be 30 years. Applicants who can fully substantiate their claim should state fully details of their technical training, practical experience, previous and present appointments and salaries, salary required and age. Applications will be treated with the strictest confidence addressed for the personal attention of the Managing Director, Address, E3554, The Engineer Office. A.

ELECTRO-MECHANICAL ENGINEER required. Good academic qualifications and recognised apprenticeship desirable. Experience in electrical and electromechanical methods of computatuon; servo theory, and instrument design preferred. Apply with full details of experience and salary required to the Personnel Manager, Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex. E5339. A.

ELECTRONIC ENGINEER required. Good academic qualifications and recognised apprenticeship desirable. Required for development work on control systems. Experience of D.C. amplifiers and computing devices an advantage. Apply with full details of experience and salary required to the Personnel Manager, Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex. E5341. A.

ENGINEER aged 23-30 years required by young and expanding engineering concern in the Midlands. Minimum qualifications: Higher National Certificate, good practical training and background, preferably with experience of machining processes, press work or tool design. A high degree of initiative will be required of the successful applicant and some experience of report writing would be an advantage. The position will necessitate a certain amount of travel within U.K. Full particulars including salary required to: Address, E5129, The Engineer Office. A.

ENGINEER SALESMAN (35-50) required by large engineering Company in Slough for developing and introducing a product previously imported, used by Steam Power Plants, Chemical Works and Marine Engineers. Minimum qualifications are Associate Membership of an Engineering Institution, practical experience of design or operation of steam plants and some commercial experience. Knowledge of German desired. Salary to commence £800 per annum but plenty of scope for advancement. Send full particulars of education and career to: Address, E5086, The Engineer Office. A.

ENGINEER SURVEYORS required by Insurance Company for the London area. Age 27-30. B. of T. Certificate. £450 rising to £650. Non-contributory pension. Box No. E3652. The Engineer Office. A.

ENGINEERING DRAUGHTSMAN, under thirty years. Nr. Wimbledon. Workshop experience and electrical knowledge essential. Write, stating age, experience and salary required to Box E3658, The Engineer Office. A.

EQUIPMENT ENGINEER required for rubber factory in S. W. England. Applicants must have good technical training and be experienced in design of special purpose machines, jigs and moulds as applied to the Rubber Industry. Apply stating age and full particulars of qualifications, experience and salary required to: Address, E5035, The Engineer Office. A.

EXPERIENCED BAKELITE MOULD MILLER required. Write in full detail to Clang Ltd. Cricklewood. London. E3642 A.

EXPERIENCED DRAUGHTSMAN required S. W. London. Knowledge of Refrigeration and Food Factory layout preferred, but not essential. Good conditions. 5 day week. Must be capable of handling complete plants on own initiative. State age, experience and salary required. Address, E3550, The Engineer Office. A.

EXPERIENCED SENIOR DRAUGHTSMEN for Constructional Steelwork. Write stating age, experience and salary required to: Address, E3555, The Engineer Office. A.

High volume production factory in the London area have the following vacancies in their Engineering Department.

1. Automobile BODY PRODUCTION ENGINEERS with wide experience of detail operation planning of high production assembly methods of pressed steel and unit construction bodies, trim manufacture and assembly and all finishing processes.
2. ENGINEER DRAUGHTSMEN with detailed knowledge of processes, plant

and equipment for assembly of automobile bodies - competent to prepare complete production layouts.
Applicants must be technically qualified to at least Higher National Certificate standard and should reply very fully stating experience, age and salary required quoting reference SPD/KB Box E5319, The Engineer Office A,

FOUR DESIGNER DRAUGHTSMAN having initiative and broad engineering experience required in S. W. district by manufacturers of chemical engineering and process equipment. Permanencies for suitable applicants. Attractive pension scheme. Please state age, experience, salary required, etc. Address, E3540, The Engineer Office. A.

GENERAL MANAGER required for branch Engineering Works in Scotland. Production, design and commercial experience essential. Excellent opportunity for suitable man. Age 40-50. Apply, giving full details of experience and salary required to: Address, E3520, The Engineer Office. A.

INGOT SALES MANAGER - male or female - to co-ordinate, develop and control the sale of Brass and Bronze ingots, Home and Export. Experience of Ingot manufacture and statistics desirable. Substantial salary, Bonus, Life and Pension Fund. Write stating experience, age, and salary required to: Address, E5170, The Engineer Office, A.

INSTRUMENT DESIGNER required for factory 15 miles West of London. Experienced in design of small mechanical movements. Salary depending on ability and experience. E5343.A.

JIG AND TOOL DESIGNERS. Several vacancies open in West London area for designers experienced in aero-engine or comparable work, able to produce on own initiative schemes for detailing. Write giving details of experience, etc. to Box A.E 107, c/o Central News Ltd., 17, Moorgate, London, E.C. 2. E5165 A.

JUNIOR ESTIMATOR required urgently for calculating weights quickly from detail drawings. Apply: Address, E5132, The Engineer Office. A

K & L Steelfounders & Engineers Limited, Letchworth, Herts, require the services of a METALLURGIST for works development duties. Applicants should possess, in addition to good professional qualifications, initiative and drive of a degree that will enable them to pursue development projects with a minimum of supervision. Experience in the technical control of alloy steel production and/or steel founding technique would be an advantage. Housing accommodation will be provided, if necessary. Replies giving details of professional qualifications and works experience, together with an indication of salary required should be forwarded to the Personnel Superintendent at the above address. E5356 A.

Leading Insurance Company require LIFT AND CRANE SURVEYORS. London and Provincial areas. Workshop experience in lift or crane manufacture essential. Some drawing office and technical training desirable. Age 26-34. Salary £450. rising to £650. Non-contributory pension scheme. Box No. E3641, The Engineer Office.A

LIVE WIRE MAN for sales organisation of Bolts, Washers, etc. Knowledge of trade and with connections. Good salary and commission, excellent prospects. Box No. "Bolts", E5051, The Engineer Office. A.

MAINTENANCE FOREMAN wanted. For large industrial Milling concern in East Anglis, age 35/45. Wide experience essential of practical side of various trades, including Turning, Canister Diemaking, Fitting, Millwrighting and general installation work, preferably connected with maintenance in food factories. Some knowledge of the theory of Engineering practice desirable. Apply giving age, qualifications, experience and salary required. Address, E3521, The Engineer Office. A.

Manufacturers of modern engineering product require a REPRESENTATIVE to control and develop sales in the Manchester area. Age approximately 35/45. Must have had previous selling experience and some general engineering training. Education and experience must be such that candidate can successfully sell at all levels. Only those giving (in confidence) full particulars, including past experience and present employment, will be considered. Box No. E3673, The Engineer Office. A.

MECHANICAL ENGINEER required. Good academic qualifications and recognised apprenticeship desirable. Preferably experienced in one or more of the following: precision mechanical design; hydraulics or pneumatic servo systems; servo theory; aerodynamics. Apply with full details of experience and salary required to the Personnel Manager, Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex. E5343. A

MECHANICAL ENGINEER wanted to take charge of small workshop and field maintenance of contractors plant. Should have had training as a draughtsman with experience in electric welding and machine shop practice, and knowledge of petrol and diesel engines. Opportunity of permanent job for young man with energy and initiative. Salary £400/£450 p.a. depending on experience. Apply: W.A.Dawson Ltd., Civil Engineering Contractors, Sundon Park, Luton, Beds. (Luton 3803) E3511 A

MECHANICAL ENGINEERS (ages 22-30) are required by Imperial Chemical Industries Limited, Billingham Division, for design, research and maintenance work. Good opportunities exist to gain wide experience in all these fields and candidates need not have done previous work of this nature. They must have a good honours degree and have had a period of industrial workshops training. Applications should be addressed to Staff Manager, I.C.I. Ltd., Billingham Division, Billingham, Co. Durham. E5342. A

PLANNING ENGINEER required by commercial vehicle manufacturers. Applicants must be thoroughly conversant with, and have had considerable experience of modern machine shop practice, process planning and plant layout. Please apply giving particulars of past experience to Box E5316, The Engineer Office. A

PRODUCTION ENGINEER. A first class man required for production of commercial and passenger vehicles. Applicants will be expected to show a successful record in similar positions and a salary commensurate with ability and experience will be paid. Applications must be made in writing giving full details of age, positions held in chronological order, and salary required to: Personnel Manager Tilling-Stevens Ltd., Victoria Works, Maidstone, Kent. E3557 A

PRODUCTION EXECUTIVE. Alarge, old established Electrical Engineering Firm requires a TOP PRODUCTION EXECUTIVE, aged from 35 to 45, as Works Manager of their London Factory. Must be capable of controlling Personnel and have a thorough knowledge of Machine Tooling, Layout, Planning, Small Batch Production and, preferably, Large Power Transformer Manufacture. The post necessitates a sound engineering training, experience in labour management and the applicant should have held a responsible executive position in a plant of some magnitude. The question of salary is regarded by the Company as an important ancillary to the attracting of the right man and a figure of £2,000 a year may be taken as a guide. Housing assistance will be given, if necessary, and the Company operates a Superannuation Scheme. Applications will be treated as strictly confidential and should be addressed to the Managing Director, Box No. E3662, The Engineer Office, A.

PRODUCTION MANAGER - for mass production of domestic appliances - Birmingham area. Applicants must have good practical engineering background, proved experience in modern methods of planned production control and the ability to co-ordinate effectively the activities of a staff in charge of unskilled mixed labour. Good prospects. Staff Pension Scheme. Age preferred 35-45. Please state age, give full details of career with positions held, together with names and addresses of references which will be treated in strict confidence. Box No. E5346.The Engineer Office. A

PRODUCTION MANAGER required for old established Engineers London Area. Applicant must have had technical education to degree standard, preferably at University. Only those with first-class experience of manufacture of intricate high precision mechanical work will be considered. Administrative experience and ability to take charge of highly skilled personnel essential. Apply stating age, positions held and salary expected to Box No. 5310, The Engineer Office. A

PRODUCTION PLANNING ENGINEER, req. for large Organisation manufacturing precision instruments, Clocks, etc. Applicant must be first class engineer, with wide experience in industrial supervision and control, and fully conversant in all phases in the production of precision instruments. Reply stating experience, salary required for Box No. E5348, The Engineer Office. A.

QUALIFIED ENGINEER (age 25-30) required for the Production Department of a Firm of Manufacturing Chemists in the London area. Applicant must have an Engineering Degree or Higher National Certificate and preferably some experience and training in Factory Management. A knowledge of time study methods would be an advantage, but is not essential. The Company is progressive and expanding and offers excellent scope and opportunity to the right man. The post is pensionable and there is in operation a Staff Participation Scheme. Minimum commencing salary £650 per annum. Write in confidence, giving fullest details of education, training, experience and age to Box Number E5347, The Engineer Office. A.

R. Silcock & Sons Ltd., Cattle Food Manufacturers, Liverpool, are appointing a SENIOR ENGINEER, well-qualified both in Mechanical & Electrical Engineering. It is essential that Applicants should have an Engineering Degree and be fully experienced in the design and installation of complete Manufacturing Units.

The position will be well-paid and pensionable. Age 35/40. A man of first-class ability, qualifications and experience is required. He will be responsible directly to the General Works Manager.

When applying, full details of experience and qualifications should be given and addressed to the General Works Manager, R. Silcock & Sons Ltd. 56, Great Howard Street, Liverpool,3. E3664. A

Required by well known South Midland Manufacturers, SECTION LEADER GRADE CONTRACT ENGINEERS responsible for Design work and direct technical correspondence with customers on specific projects for the application of Light Hydraulic to heavy industries. Write stating experience and salary required to Box No. E5350, The Engineer Office. A

SALES ENGINEER required for Senior Staff of British company in Calcutta. Must have knowledge of Diesel engines and Earth Moving Equipment. This is career appointment and will carry a salary commensurate with the candidate's qualifications and experience. Applicants should have served an apprenticeship with a reputable firm of Engineers, be of Higher National Certificate Standard and have commercial experience. Write stating age, whether married or single, qualifications and details of appointments held to Box H. 951 c/o Streets, 110 Old Broad Street, E.C.2. E5335. A

SALES ENGINEERS required for North Eastern and North Western England, with connections among Engineering Works, Plant users, etc., by leading specialised lubrication company expanding its sales staff. Salary, commission and expenses paid. Applicants should state age, engineering and sales experience, and remuneration required. Address, E3562, The Engineer Office. E3562 A

SALES MANAGER required to act as controller of overseas Agencies for large light engineering company with offices situated in the London area. Applicants should have basic training in engineering and some electronic experience would be an advantage. Knowledge of overseas markets and experience of export sales is essential. Applicants should give the fullest details of past experience with age and salary required to Box No. E5352 The Engineer Office. A

SALES MANAGER required for old established Manchester light and medium heavy Engineers. Essential qualifications, good secondary education, at least 6 years Executive Sales experience in Engineering Home and Export, including advertising with original ideas to promote new business, maintain good customer relations, and ability to control force of 20 Representatives. Pleasing personality and age between 35 and 45 years. State in confidence full details of position held, including salaries, educational background and date available. Box E3645, The Engineer Office A.

SENIOR DESIGN DRAUGHTSMAN used to small electro-mechanical mechanisms. Some knowledge of electronics, would be an advantage. Apply to Personnel Manager, ADREMA LTD., 27 Telford Way, East Acton, W. 3. E3675 A

SENIOR AND JUNIOR DRAUGHTSMEN, preferably with experience in Chemical work, required for large scale project in Yorkshire. Excellent prospects for first-class applicants in both categories. Replies, which will be treated in confidence, to the Chief Engineer, Synthetic Chemicals Limited, Knottingley, Yorkshire. E3538 A

SENIOR AND JUNIOR STRUCTURAL DRAUGHTSMEN required by Bath Consulting Engineers, above union wages will be paid to experienced applicants. Address, E5134, The Engineer Office. A

SENIOR DESIGNER required by the Rootes Group Truck Plant in Luton or Coventry. Applicants must have a wide experience of medium and light commercial vehicle design. Permanent position with good salary and pension scheme. Please apply in writing giving full particulars to The Secretarial Department, Commer Cars, Limited, Luton. E3491. A.

SENIOR DRAUGHTSMAN required by well-known Mechanical Engineers in London area. Must have sound technical engineering training and experience in the design of boiler mountings and auxiliary fittings. 5 day week. Pension fund. Apply stating age and full particulars of training, experience and salary required. Address, E5162 The Engineer Office. E5162 A

SENIOR DRAUGHTSMAN experienced in the design of electro-mechanical apparatus required for high priority work in the Gloucester district. Excellent salaries paid. Address, E5133, The Engineer Office. A,

SENIOR DRAUGHTSMAN trained and experienced in heavy engineering industry: capable of design of fabricated work, or chemical plant, or heavy hydraulic machinery. Estimating experience an advantage. Good technical background to at least Higher National Certificate standard essential. Good salary, comfortable office in Lancashire. Reply stating details of education and experience in chronological order to: Address, E3548, The Engineer Office. A

SENIOR JIG AND TOOL DRAUGHTSMAN required by commercial vehicle manufacturers. Experience of press tool work preferred. Please apply in writing giving particulars of past experience to Box E5315, The Engineer Office. A.

SENIOR VENTILATION DRAUGHTSMAN required for London Office, preferably having had experience in preparing schemes and estimates. Good working conditions, 40-hour week and Pension Scheme. Salary, according to age and experience to: Address, E3513, The Engineer Office. A

Sperry Gryoscope Co. Ltd., Great West Road, Brentford, Middlesex, require:
SENIOR DRAUGHTSMEN: (a) Electronics, and (b) with precision Electro-Mechanical experience.
JUNIOR DRAUGHTSMEN: for detail and assembly work.
PATENTS DRAUGHTSMAN experienced in electro-mechanical and radar work. Write with full details, age and salary required to the Personnel Manager. E5344 A.

Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex, require ELECTRO-MECHANICAL ENGINEER.

Good academic qualifications and recognised apprenticeship desirable. Experience in electrical and electro-mechanical methods of computation; servo theory and instrument design preferred. Apply with full details of experience and salary required to Personnel Manager. E5338 A

Sperry Gryoscope Co. Ltd., Great West Road, Brentford, Middlesex, require MECHANICAL ENGINEER. Good academic qualifications and recognised apprenticeship desirable. Preferably experienced in one or more of the following: precision mechanical design; hydraulics or pneumatic servo systems; servo theory; aerodynamics. Apply with full details of experience and salary required to the Personnel Manager. E5342 A

Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex, require ELECTRONIC ENGINEER. Good academic qualifications and recognised apprenticeship desirable. Required for development work on control systems. Experience of D.C. amplifiers and computing devices an advantage. Apply with full details of experience and salary required to the Personnel Manager. E5340. A

STRUCTURAL DRAUGHTSMAN required, fully experienced. Good conditions, 5-day week, Permanent, Canteen, etc., Apply or write marked "Confidential" to C. & S. Construction Co. Ltd., Worton Rd., Isleworth, Middx. E3642 A.

STRUCTURAL DRAUGHTSMAN required urgently by rapidly expanding company with extensive export trade; able to work with minimum supervision, knowledge of design preferred. Apply, stating salary required, age, and experience etc. to Ronald Lyon & Co., Chilton, Sudbury, Suffolk. E3649. A

and equipment for assembly of automobile bodies - competent to prepare complete production layouts.
Applicants must be technically qualified to at least Higher National Certificate standard and should reply very fully stating experience, age and salary required quoting reference SPD/KB Box E5319, The Engineer Office A,

FOUR DESIGNER DRAUGHTSMAN having initiative and broad engineering experience required in S. W. district by manufacturers of chemical engineering and process equipment. Permanencies for suitable applicants. Attractive pension scheme. Please state age, experience, salary required, etc. Address, E3540, The Engineer Office. A.

GENERAL MANAGER required for branch Engineering Works in Scotland. Production, design and commercial experience essential. Excellent oppertunity for suitable man. Age 40-50. Apply, giving full details of experience and salary required to: Address, E3520, The Engineer Office. A.

INGOT SALES MANAGER - male or female - to co-ordinate, develop and control the sale of Brass and Bronze ingots, Home and Export. Experience of Ingot manufacture and statistics desirable. Substantial salary, Bonus, Life and Pension Fund. Write stating experience, age, and salary required to: Address, E5170, The Engineer Office, A.

INSTRUMENT DESIGNER required for factory 15 miles West of London. Experienced in design of small mechanical movements. Salary depending on ability and experience. E5343.A.

JIG AND TOOL DESIGNERS. Several vacancies open in West London area for designers experienced in aero-engine or comparable work, able to produce on own initiative schemes for detailing. Write giving details of experience, etc. to Box A.E 107, c/o Central News Ltd., 17, Moorgate, London, E.C. 2. E5165 A.

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SALES ENGINEER required for Senior Staff of British company in Calcutta. Must have knowledge of Diesel engines and Earth Moving Equipment. This is career appointment and will carry a salary commensurate with the candidate's qualifications and experience. Applicants should have served an apprenticeship with a reputable firm of Engineers, be of Higher National Certificate Standard and have commercial experience. Write stating age, whether married or single, qualifications and details of appointments held to Box H. 951 c/o Streets, 110 Old Broad Street, E.C.2. E5335. A

SALES ENGINEERS required for North Eastern and North Western England, with connections among Engineering Works, Plant users, etc., by leading specialised lubrication company expanding its sales staff. Salary, commission and expenses paid. Applicants should state age, engineering and sales experience, and remuneration required. Address, E3562, The Engineer Office. E3562 A

SALES MANAGER required to act as controller of overseas Agencies for large light engineering company with offices situated in the London area. Applicants should have basic training in engineering and some electronic experience would be an advantage. Knowledge of overseas markets and experience of export sales is essential. Applicants should give the fullest details of past experience with age and salary required to Box No. E5352 The Engineer Office. A

SALES MANAGER required for old established Manchester light and medium heavy Engineers. Essential qualifications, good secondary education, at least 6 years Executive Sales experience in Engineering Home and Export, including advertising with original ideas to promote new business, maintain good customer relations, and ability to control force of 20 Representatives. Pleasing personality and age between 35 and 45 years. State in confidence full details of position held, including salaries, educational background and date available. Box E3645, The Engineer Office A.

SENIOR DESIGN DRAUGHTSMAN used to small electro-mechanical mechanisms. Some knowledge of electronics, would be an advantage. Apply to Personnel Manager, ADREMA LTD., 27 Telford Way, East Acton, W. 3. E3675 A

SENIOR AND JUNIOR DRAUGHTSMEN,preferably with experience in Chemical work, required for large scale project in Yorkshire. Excellent prospects for first-class applicants in both categories. Replies, which will be treated in confidence, to the Chief Engineer, Synthetic Chemicals Limited, Knottingley, Yorkshire. E3538 A

SENIOR AND JUNIOR STRUCTURAL DRAUGHTSMEN required by Bath Consulting Engineers, above union wages will be paid to experienced applicants. Address, E5134, The Engineer Office. A

SENIOR DESIGNER required by the Rootes Group Truck Plant in Luton or Coventry. Applicants must have a wide experience of medium and light commercial vehicle design. Permanent position with good salary and pension scheme. Please apply in writing giving full particulars to The Secretarial Department, Commer Cars, Limited, Luton. E3491. A.

SENIOR DRAUGHTSMAN required by well-known Mechanical Engineers in London area. Must have sound technical engineering training and experience in the design of boiler mountings and auxiliary fittings. 5 day week. Pension fund. Apply stating age and full particulars of training, experience and salary required. Address, E5162 The Engineer Office. E5162 A

SENIOR DRAUGHTSMAN experienced in the design of electro-mechanical apparatus required for high priority work in the Gloucester district. Excellent salaries paid. Address, E5133, The Engineer Office. A,

SENIOR DRAUGHTSMAN trained and experienced in heavy engineering industry: capable of design of fabricated work, or chemical plant, or heavy hydraulic machinery. Estimating experience an advantage. Good technical background to at least Higher National Certificate standard essential. Good salary, comfortable office in Lancashire. Reply stating details of education and experience in chronological order to: Address, E3548, The Engineer Office. A

SENIOR JIG AND TOOL DRAUGHTSMAN required by commercial vehicle manufacturers. Experience of press tool work preferred. Please apply in writing giving particulars of past experience to Box E5315, The Engineer Office. A.

SENIOR VENTILATION DRAUGHTSMAN required for London Office,preferably having had experience in preparing schemes and estimates. Good working conditions, 40-hour week and Pension Scheme. Salary, according to age and experience to: Address, E3513, The Engineer Office. A

Sperry Gryoscope Co. Ltd., Great West Road, Brentford, Middlesex, require:
SENIOR DRAUGHTSMEN: (a) Electronics, and (b) with precision Electro-Mechanical experience.
JUNIOR DRAUGHTSMEN: for detail and assembly work.
PATENTS DRAUGHTSMAN experienced in electro-mechanical and radar work. Write with full details, age and salary required to the Personnel Manager. E5344 A.

Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex, require ELECTRO-MECHANICAL ENGINEER.

Good academic qualifications and recognised apprenticeship desirable. Experience in electrical and electro-mechanical methods of computation; servo theory and instrument design preferred. Apply with full details of experience and salary required to Personnel Manager. E5338 A

Sperry Gryoscope Co. Ltd., Great West Road, Brentford, Middlesex, require MECHANICAL ENGINEER. Good academic qualifications and recognised apprenticeship desirable. Preferably experienced in one or more of the following: precision mechanical design; hydraulics or pneumatic servo systems; servo theory; aerodynamics. Apply with full details of experience and salary required to the Personnel Manager. E5342 A

Sperry Gyroscope Co. Ltd., Great West Road, Brentford, Middlesex, require ELECTRONIC ENGINEER. Good academic qualifications and recognised apprenticeship desirable. Required for development work on control systems. Experience of D.C. amplifiers and computing devices an advantage. Apply with full details of experience and salary required to the Personnel Manager. E5340. A

STRUCTURAL DRAUGHTSMAN required, fully experienced. Good conditions, 5-day week, Permanent, Canteen, etc., Apply or write marked "Confidential" to C. & S. Construction Co. Ltd., Worton Rd., Isleworth, Middx. E3642 A.

STRUCTURAL DRAUGHTSMAN required urgently by rapidly expanding company with extensive export trade; able to work with minimum supervision, knowledge of design preferred. Apply, stating salary required, age, and experience etc. to Ronald Lyon & Co., Chilton, Sudbury, Suffolk. E3649. A

THE BRITISH OXYGEN Company Limited has vacancies in their Edmonton Technical Dept., and invite applications for the following:

SENIOR MECHANICAL DESIGNER -DRAUGHTSMAN with experience in design of small special purpose machines and equipment. Some electrical knowledge an advantage but not essential.

SENIOR MECHANICAL DESIGNER-DRAUGHTSMAN with experience in design of reciprocating gas compressors and/or rotary and reciprocating hydraulic pumps.

SENIOR MECHANICAL DRAUGHTSMAN for layout and detail drawing work on Gas Separation Plants. Previous experience on this class of work is not essential and men with suitable technical qualifications and good mechanical drawing office experience will be considered.

JUNIOR MECHANICAL DRAUGHTSMAN. Age 21-25. Education to O.N.C. standard and at least 2-3 years practical D.O. experience.

Five-day week, Staff Pension Scheme, initial salary according to experience and qualifications. Applications, stating age, experience and salary expected should be addressed to: The Personnel Dept., The British Oxygen Co. Ltd., Angel Road, Upper Edmonton, London, N. 18. E5168 A

The following vacancies exist in Wiltshire, at a light Engineering Works employing approximately 2,000 people.

ASSISTANT CHIEF INSPECTOR. Must have considerable mechanical and some electrical experience, having held similar position with A.I.D. approval. Experience of commercial work particularly in reference to Automatics. Age 35-45 years.

CHIEF JIG AND TOOL DRAUGHTSMAN. Drawing office personnel of 12. Age 30-45 years.

PERSONNEL MANAGER. Responsible for all engagements male and female. T.U. Negotiations. Factories acts. Welfare. Preferably corporate member of I.P.M. Age 30-45 years.

Applicants who have held similar positions to the above are asked to forward full details regarding age, experience and salary required to: Address, E5089, The Engineer Office. E5089 A

TRANSFORMER TEST ENGINEERS required for work on Test Bed of a large Midlands Manufacturer. Applicants should preferably have had previous experience on medium sized power transformers, and some experience with instrument transformers would be an asset. Excellent opportunities for advancement under good working conditions for the right type of men. Reply giving details of experience, age, salary required, etc., to : Address, E5181, The Engineer Office, A.

2 CIVIL ENGINEERING DRAUGHTSMEN required by general engineering firm on Tees-Side. To be capable of preparing drawings reinforced concrete work and have sound knowledge site surveying work. State age, experience, salary required Box No. E5362, The Engineer Office. A.

2 GENERAL ENGINEERING DRAUGHTSMEN wanted by firm on Tees-Side. Accustomed to layout of plant, design of pressure vessels, platework, pipework etc. Give age, experience, salary required. Box No. E5363, The Engineer Office. A.

2 ELECTRICAL ENGINEERING DRAUGHTSMEN wanted by Tees-Side firm, General & Chemical Engineers. To be experienced in the design, layout and installation of complete electrical equipment for gas, chemical and other plants. Apply giving age, experience, salary required Box No. E5364 The Engineer Office. A.

TWO JIG AND TOOL DRAUGHTSMEN required by well-known Mechanical Engineers in London area. Must have sound technical engineering training including machine shop experience. 5 day week. Pension fund. Apply stating age and full particulars of training, experience and salary required to: Address, E5161, The Engineer Office. A.

TWO JUNIOR CALCULATORS are required, S.W. London area, with workshop training and sound theoretical knowledge of heat and hydraulics, preferably of H.N.C. standard. The work is of an interesting nature and carries good prospects of advancement Bonus and Pension Schemes operating. Full details of previous experience should be addressed to Box No. E5322 Bensons, Kingsway Hall, Kingsway, W.C.2. E5322 A

Vauxhall Motors Ltd., Luton require a PLANT MECHANICAL ENGINEER. Applicants must have had sound practical training with proved experience in all aspects of Plant Mechanical Service, Compressed Air and Producer Gas as applied to a large Mass Production Factory. Must be a good organiser with drive and initiative and be capable of handling skilled and semi-skilled labour, and preferably be a corporate member of the Institution of Mechanical Engineers. Applications should be submitted with details of previous employment and positions held in chronological order date of birth, etc. Salary will be according to experience and ability. This is not a temporary appointment, but offers a long term engagement to a suitably qualified man. Applications to Route 215, Vauxhall Motors Ltd., Kimpton Road, Luton. E3535 A

WORKS CHEMIST required for medium-sized Engineering Works with Iron Foundry. Must have Metallurgical experience. State age, salary expected and experience. Box E5312, The Engineer Office. A

WORKS SUPERINTENDENT required for Land Boiler Division of well-known Engineering Co. A works superintendent for new works being constructed on Clydeside.
Must have experience in works organisation, production control and management of labour. Experience in production of steelwork, platework and pipework fabrication desirable. Post permanent and superannuated. Fullest information in first letter to Box No. E3676, The Engineer Office.A

Worthington-Simpson Ltd. require DRAUGHTSMEN as follows (a) Centrifugal Pumps (b) Air Compressors (c) General Engineering. Apply by letter stating age and experience to Worthington-Simpson Ltd., Newark, Notts. E5334. A

YOUNG DESIGN ENGINEER required, age 28 - 35, capable of designing and supervising the production of a mechanised plant for a precision moulding process. Metallurgical knowledge would be an asset but not essential. This post offers excellent opportunities. Salary £650 - £850 according to experience. Box No. E3646, The Engineer Office. A

YOUNG GRADUATE in mechanical engineering required for plant and process development. The work covers a wide field and calls for a sound theoretical knowledge as well as originality and personal initiative. Excellent working conditions and contributory pensions scheme. Applications to the Technical Director, Fibreglass Ltd., Ravenhead, St. Helens. E3647. A

SITUATIONS WANTED

A.M.I.Mech.E. 34 years of age, Public School education, seeks position as an ASSESSOR with well established Industrial Insurance Company. Fourteen years varied light Engineering experience at home and abroad. Strong personality and appearance. Address, E3492, The Engineer Office. B.

A.M.I.Mech.E; A.F.R.Ae.S., 34 years of age, single, thirteen years experience both Technical and Practical seeks position with reputable firm on Technical Sales Staff or on Liason at home or abroad. Three years Continental experience, smart appearance and address, languages French and German. Address, E3493, The Engineer Office. B.

Engineer. H.N.C., (under 40) requires progressing post. Works trained, Design, Planning, Purchase and Tech. Sales exp., M/c Tools, Gen. Bearing and Synthetics. Box No. E3671, The Engineer Office. B.

Engineer, 35, 1st class B.O.T. Certificate, Student I.C.S. Electricity, eight year Civil Service Marine Department desires position South England. Own car. Free New Year. E3670, The Engineer Office. B.

Mechanical Engineer, presently with Oil-Refinery Engineers, seeks interesting position London area. 20 years experience England and abroad. General - Heating - Steam - Engineering - 3 Languages. Address E3668, The Engineer Office. B.

Proceeding Australia near future, Grad. M.I.Mech.E., desirous contacting U.K. firm with view to position on arrival as Sales Engineer or any other suitable appointment. Wide experience covers work on vehicles, mining equipment, agricultural machinary, and construction. Three years recent experience in N. America. Extensive travel in Far & Middle East as British and Indian Army workshop officer. Age 33. Address, E3665, The Engineer Office. B.

Production Director seeks change. Many years absolute control of manu-

facture motor and general engineering expert knowledge tooling and production. Opening required as works director or general manager. Post E3672, The Engineer Office. B.

Production Engineer wide experience seeks executive post trained in time and motion study, methods, layout, production control, planning, material handling, etc., Box No. E3666, The Engineer Office. B.

BUSINESS OPPORTUNITIES

Company Director, in managing capacity seeks change - appointment required with important Engineering concern. Qualified Engineer, with Honours, wide experience of production, costing and sales - will take full control - act as deputy or consider position of Works Director or General Manager, according to nature of undertaking. Address, E3617, The Engineer Office. O.

SUB-CONTRACTS

A MANUFACTURING PROPOSITION WITH NO DESIGNING, NO SELLING RESPONSIBILITIES; Well-known Machine Tool Makers requiring additional capacity immediately would welcome an association with a well-equipped firm of Engineers for the production of high class Precision Machine Tools of total weights from 5 to 30 tons. Advertisers would supply all designs, detail drawings and full technique, and could guarantee a substantial volume of business for some years to competent producers. A Company with its own foundry, located in a comparatively small town where there is some skilled and lots of unskilled labour available, would be perfect, alternatively a Company in one of the so-called Development Areas would be welcome. Advertiser could give manufacturer financial assistance if required. Replies, which will be treated with strict confidence, should be addressed to Chairman, Address, E3612, The Engineer Office. MW.

Competent Architectural Designer, with staff is now in a position to help out Engineers and Civil Engineering Contractors. Complete schemes from sketch plan to working drawings and details prepared. 'Phone MUSeum 5322. E3494 MO.

Gunhill & Co., Precision to medium engineering design, detailing, or Drawing work undertaken by qualified staff. Special attention to urgent orders. Address, E3616, The Engineer Office, MW.

Capacity available at London Works 50,000 sq. ft. floor area. Mechanical-construction work, Machining, Fabrication, Erection and Toolmaking. Address, E3544, The Engineer Office. MW.

All classes Drawing, Detailing, Tracing etc. undertaken. Prompt and efficient service. Estimates on request. K.A. Stroud, 16, Shirley Close, Worthing, Sussex. E3502 MW.

Production capacity urgently required from Knuckle Action Coining Presses, 1500 tons capacity. It is desirable that Tool Making Capacity should be available for this machine. Write Box No.A.590, Haddons, Salisbury Square, London, E.C.4. E5341 MW.

Capacity available for skilled instrument work and light engineering. We are particularly experienced in prototype work. J.Napier Proctor & Partners, 4, Blomfield Road, London, W.9. CUN 5449 and 0826. E3587 MW.

BUSINESSES & PREMISES

FOUNDRY AND ENGINEERING WORKS FOR SALE IN ESSEX.

Ground Floor premises of 36,000 sq. ft. covered area on a Freehold site of 5 acres. Offices, Canteen, Stores, Foundries, Pattern, Fettling and Core shops. Fully equipped with Foundry plant and machinery to be sold complete as a going concern. Price £60,000. Further details from: Chamberlain & Willows, Surveyors, 23, Moorgate, London, E.C.2. (City 6013). E5092 L.

HEREFORD. Freehold Factory Premises 6,000 sq.ft. with Offices and ¾ acre of Land for extension. Equipped with dehydrating and cider manufacturing plant. Suitable for food processing, bottling, canning, etc. or many other industrial purposes. For Sale Equipped or with Vacant Possession Would Let. Full particulars from Henry Butcher & Co., 73, Chancery Lane, London, W.C.2. E5042 L.

Surrey. Engineering factory with 5,500 sq. ft. and detached living accommodation of 4 bedrooms etc. is offered complete with equipment for £10,000. Apply: Commercial Development Co. (Sevenoaks) Ltd., 199, London Road, Sevenoaks, Kent. (Sevenoaks 3054). E5153 L.

London, E.C.2. Very fine offices to let on lease. Three large rooms, suitable for London Offices of important manufacturing concern. Full particulars from Victor R.Smith & Co.Ltd., Imperial House, Dominion Street, London, E.C.2. E5272 L.

Wallasey, Cheshire. Splendid factory premises of modern planning and construction close to Birkenhead Docks and Mersey Tunnel. Two Loading Bays and four road entrances. Private siding. Single storey factory 73,173 sq. ft. Office block 4,294 sq. ft. Site area nearly 3 acres. Ample labour in district. Illustrated brochure from Sykes Waterhouse & Co. 1, Castle Street, Liverpool. Central 7112/6. E3571 L.

Engineering Precision Tool and Manufacturing business and brassfoundry Birmingham, magnificently equipped - full order books, big turnover/profits. Price £35,000 includes valuable machinery and spares alone worth more. Owner going abroad. Full details in strictest confidence. Gordon Bentley, Estate Agents, St.Martins Place, Birmingham, 1. E3644 L.

Special opportunity of acquiring first class West-End London offices. Owners prepared to let only to gilt-edged tenants on long lease 1,400 square fee at 12/6 per foot (worth 17/6 a foot). Possession by September next or earlier by arrangement. Apply Dudley Samuel & Harrison Ltd.,11,Bruton Street, London, W.1. Tel: Mayfair 7111. E3660 L

MISCELLANEOUS

Well established firm of Constructional Engineers seek to sublet preparation of shop detail drawings for light and medium structural steelwork. Address, E3611, The Engineer Office. I.

A Chartered Engineer A.M.I.E.E. age 35, speaks French, seeks London or Continental appointment. Advertiser who is at present holding the position of sole London Representative to a concern of high repute in the non-ferrous metal industry, has wide field of technical and commercial experience in the electrical, metallurgical and light engineering industries. Would be prepared to reside in France, Belgium or Switzerland, or would represent a Continental firm in London. Address, E3527, The Engineer Office. I.

Stop watches, seconds timers, process timers - sale, maintenance and repair. Specialised instruments made to order. Instrument Division, J.Napier Proctor & Partners, 4, Blomfield Road, London, W.9. CUN 5449 and 0826. E3586 I.

AGENCIES

Agents with established contacts required by a leading firm of manufacturers of centrifugal and special process pumps for Lothians, Fife and Border Counties. Address: E5346, The Engineer Office. D

Engineers agents required to represent Pump Manufacturers on commission basis in South Wales area. Address: E5348, The Engineer Office. D

PATENTS

The proprietor of British Patent No. 592406, entitled "Improvements in or relating to fluid pressure control systems" offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer Stern & Carlberg, 14. East Jackson Boulevard, Chicago 4, Illinois, U.S.A. E5104 H.

The proprietor of British Patents Nos. 510812, 56372, 491026 and 555460, entitled "Improvements in or relating to injection molding presses" "Improvements in and relating to relief valves", "Improvements in or relating to hydraulic presses" and "Improvements in or relating to hydraulic pumps" respectively, offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14, East Jackson Boulevard, Chicago 4, Illinois, U.S.A. E5081 H.

The Proprietors of British Patent No. 556542 relating to "An Improved Method and Apparatus for Mixing Granular or like Materials", desire to enter into negotiations with one or more firms in Great Britain for the sale of the Patent rights or for the grant of Licence to manufacture under Royalty.
Enquiries to be addressed to D.YOUNG & CO., Chartered Patent Agents, 29, Southampton Buildings, London, W.C.2.
E5304 H

The proprietor of British Patent No. 491160, entitled "Improvements in or relating to electrical control systems for presses" offers same for license or otherwise to ensure practical working in Great Britain.
Inquiries to Singer, Stern & Carlberg, 14, East Jackson Boulevard, Chicago 4, Illinois, U.S.A. E5080 H.

FOR HIRE

STEAM CRANES FOR HIRE

One 5-ton Smith Steam Loco Crane. 35 ft. Jib, 4'8½" gauge.
One 5-ton Grafton Steam Loco Shunting Crane. 35 ft.Jib, 4'8½" gauge.
Abelson & Co. (Engineers) Ltd., Coventry Road, Sheldon, Birmingham, 26. 'Phone Sheldon 2424. E5034 K.

WANTED

Plant Wanted
Wheelabrator Sandblasting Machine complete in first class order. Turner Manufacturing Co.Ltd., Wulfruna Works, Villiers Street, Wolverhampton.
E5309 F.

Wanted urgently by well known concern Industrial premises at Wimbledon, Putney, Kingston, etc., Area about 20/30,000 sq. ft. preferably with land for extension. Details in confidence to: Hampton & Sons Ltd., 6, Arlington St. St.James, S.W.1. E5350 L.

Urgently Wanted. One 8' x 1/8" capacity press brake fully motorised 400/440 volts, 3 phase, 50 cycles. Good condition and fairly modern. Address, E3677, The Engineer Office. F.

Wanted - 6'0" All Geared Radial Drilling Machine. Pillar Drilling Machine to drill up to 2" capacity, or near. Both machines motorised for 400/3/50. Address, E5358, The Engineer Office. F.

Wanted - Secondhand Lathe, cone pulley drive would be considered, to swing 44" over the saddle and admit 16-17' between centres. Screwcutting not required. Address, E5359, The Engineer Office. F.

Wanted - One good Secondhand "Churchill" No. 2 Centreless Grinding Machine, motorised for 400/3/50 cycles supply. Address, E5360, The Engineer Office. F.

FOR SALE

"Admel", Corona Vertical Non-Continuous Photo-Printing Machine. Type D.L. single side 30" x 40" cylinder, complete with developing machine, perfect condition, rolls of Monex paper and tins of developer. Address, E5361, The Engineer Office. G.

C.W.B. Boring Machines. Enquiries for Vertical and Horizontal models accepted by Thos.W.Ward Ltd., Albion Works, Sheffield. E5366 G.

FOR SALE. 6-ton Koehring Mobile Crane, petrol driven, 20 ft jib, all round slewing type, solid rubber tyres.
5-ton Morris Standard type petrol/electric Mobile Crane, solid rubber tyres.
5-ton Morris Versatile petrol/electric Mobile Crane, solid rubber tyres.
5-ton Henderson Guy Derrick, 86 ft. jib, 100 ft. mast, 100 lb. boiler.
3-ton Butters Hand Derrick, 45 ft. jib, all steel construction.
2-ton Neals type "NM" all round slewing Mobile Crane, pneumatic tyres, Ruston Diesel engine.
2-ton Chaseside Mobile Crane on Fordson chassis, petrol engine, large pneumatic tyres.
2-ton Rushworth Hand Derrick Crane with 40 ft. jib,
1-ton Smith all round slewing Crane, Lister Diesel engine, large pneumatic tyres.
1-ton Neals all round slewing Mobile Crane, Ruston diesel engine, pneumatic tyres.
30-cwt Hand Winch.
All enquiries to: ABELSON & Co. (ENGINEERS) LTD., COVENTRY ROAD, BIRMINGHAM. Tel: Sheldon 2424 or Harrow 2253 or Manchester, Ardwick 1328. E5365 G.

FOR IMMEDIATE DELIVERY.
10" x 24" 'CHURCHILL' Hydraulic Universal Grinding machine Reconditioned - Maximum swing over table 11". Fitted with 12" x 1½" grinding wheel to grind taper including angle of 9 degrees. 84 - 356 r.p.m. work head speeds. Traverse hydraulically operated. Variable up to 180" per minute, complete with internal grinding attachment 6" - 4 jaw independent chuck 9" faceplate. Wheel dresser. Pump and fittings, motorised for 400/440/3/50 cycles supply.
36" 'PRECIMAX' Vertical spindle rotary Surface Grinder, reconditioned. Type VRS.36. 36" dia. table 36" dia. magnetic chuck, max.distance from table to wheel 18". max.distance from chuck to wheel 13". 4 table speeds 6 - 9 - 12 - 18 r.p.m. 20" dia. grinding wheel fitted with new segments, running at 950 r.p.m. Independent motor drive to table and rapid feed. Motorised for 400/440/3/50 cycles supply.
10" x 27" Reconditioned 'JONES & SHIPMAN' Hydraulic Surface Grinder, working surface of table 27" x 10". Overall size of table 37" x 10", fitted with new 10" dia. grinding wheel, motorised for 400/440/3/50 cycles supply.
24" 'ROWLAND' double ended Disc Grinder Machine as new. Spindle speeds 1,120 r.p.m. fitted with 2 - 24" abrasive discs fitted with 'T' slotted type swivelling work tables for accommodation of fixtures etc. Tables are adjustable for height and swivel, table size 12" x 12". Machine is fitted with two Lovo lights and spenstead motorised Dust extractor unit, and extractor fan, motorised for 400/440/3/50 cycles supply.
24" Reconditioned 'BULLARD' Vertical Boring and Turning Mill, fitted with 24" chuck with a max. swing of 26". 12" table, speeds from 10 to 63 r.p.m. Power down feed to turret, vertical movement to turret slide 9", horizontal movement to turret slide 16", side head fitted with 4-way toolpost, maximum distance from turret face to table 18". Rapid power traverse to horizontal and vertical movement of turret, motorised for 400/440/3/50 cycles supply. JOHN CASHMORE LIMITED, Newport, 6, Mon. Tel: 3944-5-6.
E5352 G

B. C. S.
SWITCHGEAR
(A) 10 Panel Metalclad Allen West Drop-down truck type O.B.1. Low Tension Switchboard, new 1940, 400/3/50, complete with Circuit Breakers, 750 amps. capacity, 15 M.V.A. Rupturing capacity, all necessary relays, instruments, transformers etc.,new 1940.
B.C.S. (ENGINEERS & CONTRACTORS) LTD., 3, Castle Street, Cardiff. Tel: Cardiff 8512/3/4.
E5355 G.

FOR SALE: Jib Crane. All steel hand derrick with 40 ft. steel jib, steel mast stays and sleepers, complete with wire ropes. In good condition. Apply James Porter & Son Ltd., St. George's Bridge Wharf, Norwich.
E3655 G.

B. C. S.
BOILERS
(A) 32,000 lbs. per hour UNUSED, Self contained, Three drum, Marine type Water tube Boiler by Thornycroft, heating surface 4630 square feet, working pressure 250 lbs.per sq.inch, complete with a full complement of new fittings and mountings: Can be arranged for oil or coal firing.
(B) 25,000 lbs.per hour Babcock & Wilcox single drum C.T.M.type Boiler, new 1925, heating surface 3488 sq.ft. working pressure 195 lbs. p.s.i. complete with Chain Grate Stoker, Superheater, Super-imposed Economiser, F.D. Fan, Soot Blowers, Valves & Gauges. (2 available). First-class condition
(C) 15,000 lbs.per hour Babcock & Wilcox single drum type C.T.M.Water tube Boiler, new 1921, heating surface 2586 sq.ft., working pressure 195 p.s.i., complete with Chain Grate Stoker, Superheater, Super-imposed Economiser, F.D.Fan, Soot Blowers, Valves, Gauges, etc. (2 available). First class condition.
(D)3000 lbs.per hour Blake vertical Multitubular Boiler, 6'6" dia. x 14'6" high, new 1929, working pressure 125 lbs.p.s.i., complete with fittings and mountings, coal fired.
(E) 1250/1650 lbs.per hour Ruston Thermax vertical Multitubular Boiler, 4'7" dia. x 11'3" high, new 1941, 100 lbs. working pressure, complete with fittings and mountings, stack, feed pump, piping and Hotwell.
(F) 1200 lbs.per hour Danks self-contained Economic Boiler, new 1941, 5'0" dia. x 9'0"long, single flue, 100 lbs. working pressure, complete with fittings and mountings (2 available).
(G) 700 lbs.per hour vertical cross

tube Boiler by Beaver & Co.,3'6" dia. x 9'0" high, 80 lbs working pressure, complete with fittings and mountings. S.C.S.(Engineers & Contractors) Ltd., 3, Castle Street, Cardiff. Tel: Cardiff 8512/3/4.

E5354 G.

COPPER TUBES. 10mm x 8mm, ¼" nominal bore, 9/16" x 18/20G. 20mm x 18mm, 1¼" x 20G. BRASS TUBES. 4mm x 3mm, ¼" x 20G. and 26G., 10mm x 8mm, 12mm x 10mm, 15mm x 18G. BRASS RODS. 50 tons Inch and Millimetre sizes from .413" to 2". Enquiries to D.A.D.ANIEL & CO., 31/33 Bishopsgate, E.C.2. Tel: LONdon Wall 3263.

E3659 G.

NEW ELECTRICALLY-DRIVEN CENTRIFUGAL PUMPING SETS. UNITS UP TO 100 FT. HEAD.
65 GPM/50 ft.head. 2"Single-stage Pump type CF200, direct coupled on bedplate to 2 H.P.S.C.1425 RPM Motor, 400/440-3-50.
90 GPM/20ft.head. 2" Single-stage Pump by Pulsometer type K2, direct coupled on bedplate to 1½ H.P.S.C. 1425 RPM Motor, 400/440-3-50.
125 GPM/90ft.head. 1½" Single-stage Pump by Pulsometer type LEX-1½, direct coupled on bedplate to 7½ H.P.S.C. 1440 RPM Motor, 400/440/3-50 or 500/550-3-50.
175 GPM/88ft.head. 2" Single-stage Pump by Pulsometer type LEX-2, direct coupled on bedplate to 10 H.P.S.C.Motor, 1440 RPM 400/440-3-50 or 500/550-3-50.
200 GPM/50ft.head. 4" self-priming Single-stage Pump by Pulsometer type KPX-4, direct coupled on bedplate to 7½ H.P.S.C.1440 RPM Motor,400/440-3-50 or 500/550-3-50.
250 GPM/40ft.head. 3" Single-stage Pump type CF310, direct coupled on bedplate to 7½ H.P.S.C.1440 RPM Motor, 400/440-3-50 or 500/550-3-50.
325 GPM/100ft.head. 3" Single-stage Pump by Pulsometer type LEX-3,direct coupled on bedplate to 15 H.P.S.C., 1450 RPM Motor, 400/440-3-50 or 500/550-3-50.
400 GPM/43ft.head. 4" Single-stage Pump by Pulsometer type A4, direct coupled on bedplate to 10 H.P.S.C. 1440 RPM Motor, 400/440-3-50 or 500/550-3-50.
450 GPM/27ft.head. 4" Single-stage Pump type CF410, direct coupled on bedplate to 10 H.P.S.C.1440 RPM Motor, 400/440-3-50 or 500/550-3-50.
600 GPM/35ft.head. 5" Single-stage Pump by Pulsometer type K5, direct coupled on bedplate to 15 H.P.S.C. 1450 RPM Motor, 400/440-3-50 or 500/550-3-50.
750 GPM/100ft.head. 4" Single-stage Pump by Pulsometer type LEX-4,direct coupled on bedplate to 40 H.P.S.C. 1450 RPM Motor, 500/550-3-50.
800 GPM/70ft.head. 5" Single-stage Pump by Pulsometer type LEX-5,direct coupled on bedplate to 28 H.P.S.C. 955 RPM Motor, 400/440-3-50.

UNITS OVER 100 FT.HEAD.
14 GPM/300ft.head. 1½" 2-stage self-priming Pump by G.G.G.type 125 BS, direct coupled on bedplate to 5 H. P.S.C.Motor, 2900 RPM 400/440-3-50.
50 GPM/300ft.head. 1½" Turbine Pump by Gwynne type Pl½/6, direct coupled on bedplate to 5 H.P.S.C.Motor, 2900 RPM, 400/440-3-50 or 500/550-3-50.
60 GPM/140ft.head. 1½" Single-stage Pump by Pulsometer type BEMX-1½,direct coupled on bedplate to 5 H.P.S.C. Motor 2900 RPM 400/440-3-50.
80 GPM/150ft.head. 2" 2-stage Pump by Pulsometer type HSRB-2, direct coupled on bedplate to 7½ H.P.S.C.Motor, 1440 RPM,400/440-3-50 or 500/550-3-50.
110 GPM/400ft.head. 1½" 2-stage Pump by Pulsometer type HSRB-1½, direct coupled on bedplate to 30 H.P.S.C. Motor, 2900 RPM, 400/440-3-50 or 500/550-3-50.
125 GPM/400ft.head. 2" Turbine Pump by Gwynne type P2/4, direct coupled on bedplate to 30 H.P.S.C.Motor, 2900 RPM,400/440-3-50 or 500/550-3-50.
175 GPM/480ft.head. 4" 2-stage Pump by Mather & Platt, type 4"/6" CH. Pluro, direct coupled on bedplate to 70 H.P.S.C.Motor, 2950 RPM, 400/440-3-50.
250 GPM/175ft.head. 3" 2-stage Pump by Pulsometer type HSRB-3, direct coupled on bedplate to 25 H.P.S.C. Motor, 1450 RPM,400/440-3-50 or 500/550-3-50.
350 GPM/185ft.head. 4" 2-stage Pump by Pulsometer type HSRB-4, direct coupled on bedplate to 30 H.P.S.C. Motor, 1450 RPM 400/440-3-50 or 500/550-3-50.
400 GPM/150ft.head. 4" Single-stage Pump by Pulsometer type LEX-4,direct coupled on bedplate to 30 H.P.S.C. Motor, 1450 RPM,400/440-3-50 or 500/550-3-50.
500 GPM/420ft.head. 6" Turbine Pump by Pulsometer type T6a/6,direct coupled on bedplate to 100 H.P.S.C.Motor, 1460 RPM, 500/550-3-50.
600 GPM/150ft.head. 5" 2-stage Pump by Pulsometer type HSRB-5,direct coupled on bedplate to 50 H.P.S.C.Motor, 1460 RPM 400/440-3-50.
750 GPM/118ft.head. 5" Single-stage Pump by Pulsometer type LEX-5, direct coupled on bedplate to 45 H.P.S.C. Motor, 1460 RPM 400/440-3-50.

NEW DIESEL DRIVEN CENTRIFUGAL PUMPING SETS.
150 GPM/110ft.head. 3" Single-stage Pump by Pulsometer type LEX-3,direct coupled on bedplate to 1-VSH Ruston Hornsby Diesel.
400 GPM/90ft.head. 4" Single-stage Pump by Pulsometer type LEX-4, direct coupled on bedplate to 2-VSH Ruston Hornsby Diesel.

ENQUIRY DETAILS. With enquiries kindly furnish the following data, estimated quantity and total head in ft. if water or other liquid. Re.motor; type of enclosure preferred.
BERRY HILL PLANT DIVISION, CHEADLE, STAFFS. Tel: CHEADLE 2181 & 2261.

E5303 G.

MODERN BOILERS.
Cochran No.22 built 1949. 155 lbs working pressure. 4960/6600 lbs.evaporation. With Automatic Stoker, Ronald Trist Controls.
Cochran No.18 built 1944. 105 lbs. working pressure, 2750/3600 lbs.evaporation. With underfeed Stoker. Ronald Trist Controls.
John Thompson Oil Fired Super Economic Boiler, built 1940, 8000/10,000 lbs evaporation, 180 lbs.working pressure. With Induced Draught Fan and Clyde Oil Burning equipment.
John Thompson Economic Boiler built 1934. 6000/7000 lbs evaporation, 150 lbs.working pressure, with Bennis Air Draught Stoker.
FOR EXPORT ONLY.- Reconditioned Babcock & Wilcox Water Tube Boiler, 43,000 lbs.evaporation, 200 lbs.w.p. with New Chain Grate Stoker, Economiser, Fans and Chimney.
Several Modern small cross tube Boilers.
REED BROTHERS (ENGINEERING) LTD., Replant Works, Cuba Street, Millwall, London, E.14. Cables: REPLANT,POP, LONDON.

E5317 G.

HYDRAULIC PLANT .
PRESSES:
400-ton VERTICAL FOUR COLUMN UPSTROKING by GREENWOOD AND BATLEY, ram 16" dia. 2'6" stroke w.p. 2-tons p.s.i.table 34" x 17" maximum daylight 4'2".
250-ton VERTICAL FOUR COLUMN UPSTROKING ram 18" dia. x 14" stroke, w.p.1-ton p.s.i.max.daylight 14" Table 30" x 14½".
70-ton VERTICAL UPSTROKING AND SIDE RAM by Berry w.p. 1-ton p.s.i.vert. ram 10⅜" dia. 17" stroke. Daylight 30" Side ram 8" dia. x 6" stroke.
50-ton HAND OPERATED HIGH SPEED HYDRAULIC "ARBOUR" PRESS, pump ram 5" dia. x 7" stroke, width between frames 42" automatic ram return. Suitable for removing ball race, pinions, axle straightening etc.
35-ton VERTICAL UPSTROKING AND SIDE RAM by Bradley and Turton w.p. 1-ton p.s.i.vert.ram 7" dia. x 12" stroke. Daylight 15" side ram 8" dia. x 3".
10-ton DOWNSTROKING BENCH PRESSES by DAVY AND UNITED, ram 3½" dia. x 6" stroke 12" daylight Table 12" square, Jacking ram for return stroke.
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PUMPS:
HORIZONTAL THREE THROW by FULLERTON HODGART & BARCLAY, rams 3½" dia. x 9" stroke. 1000-lbs.p.s.i.pressure 120 H. P.S.R. Motor and Oil Immersed Starter.
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FOR SALE
1 ton Electric Melting Furnace, consisting of 6 ft.dia.steel tank, constructed 5/8" thick steel plate, three doors, for charging and working. A 3.ph.transformer, oil filled, natural cooled automatic control gear. Tilting motor controlled by drum controller. For further information apply Jonn Cashmore Limited, Engineer, Newport 6, Mon. Tel: 3944(4 lines).

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A Seven-Day Journal

The Opening of Parliament

THE second session of the present Parliament was opened on Tuesday morning last, with traditional State ceremonial, by His Majesty the King, who, with Her Majesty the Queen, drove to the House of Lords. The Princess Elizabeth, Duchess of Edinburgh, also attended the ceremony. In the Speech from the Throne the King made reference to the necessary increases in production for defence which would call for further efforts and sacrifices. Forthcoming legislation outlined in the Speech included powers, on a permanent basis, but subject to appropriate Parliamentary safeguards, to regulate production, distribution and consumption and to control prices. This, the Speech indicated, was necessary to defend full employment, to ensure that the resources of the community were used to the best advantage, and to avoid inflation. Other measures foreshadowed were provision for the restoration of land devastated by ironstone extraction; provision for placing on a permanent basis legislation relating to the beet sugar industry and to transfer to public ownership the shares in the British Sugar Corporation not at present held by the Exchequer; a Bill to amend the Restoration of Pre-War Trade Practices Act, 1942; and a measure to provide River Boards with more effective powers to deal with the pollution of rivers and streams.

Shipbuilding Costs

IN his address, delivered at the end of last week, Mr. J. Lenaghan, this year's chairman of the Tees-side branch of the North-East Coast Institution of Engineers and Shipbuilders, reviewed the production costs of ships and gave comparative ratios for a number of equipment items based upon 100 as the unit for 1939. The estimated overall figure for 1950, he said, was 282, and the individual 1948 costs were 181 for steel, 317 (average) for timber, 434 for paints, 628 for life-saving equipment, 433 for electrical fittings and 571 for heating and ventilation, with labour at 225 for 1948 and estimated at 243 for 1950. Mr. Lenaghan remarked that with high costs shipowners were unable to make sufficient allowance for replacements, which affected the policy of scrap and build, and would eventually result in empty berths, unless prices were reduced. Building time, he claimed, had been nearly doubled and the industry was endeavouring by new methods of construction to produce ships cheaper, although shipyard charges were only 21 per cent of the total cost. Changes in this direction would be slow because plant renewal was costly and the conservatism of shipbuilding labour circles delayed the realisation of the full effects.

Lloyd's Register Shipbuilding Returns

THE returns for the quarter ended September 30, 1950, issued by Lloyd's Register of Shipping, show that 323 steamers and motorships, of 2,046,234 tons gross, were under construction, representing an increase of 109,043 tons over the previous quarter, but 197,469 tons less than the figure recorded in June, 1948. During the quarter 387,650 tons were laid down, 307,472 tons were launched, 288,858 tons were completed and 1900 tons were suspended. The tonnage being built for abroad is the highest recorded since the war and the total of 825,745 tons, of which 152,339 tons were commenced this quarter, represents 40·4 per cent of the tonnage under construction in this country. Construction of oil tankers of over 1000 tons increased by 121,553 tons over last quarter to 1,110,340 tons, being 54·3 per cent of the total tonnage under construction in Great Britain and Northern Ireland. New work, for which plans had been approved or material ordered, amounted to 831,642 tons, of which 73 per cent are oil tankers. At 2,792,911 tons gross, the amount of steamers and motorships being built abroad was 180,181 tons greater than at the end of June; 172,744 tons of the increase being due to the inclusion of figures for Germany. Figures are not available for China, Poland and Russia. During the quarter work was begun on 391,140 tons, 475,067 tons were launched, 380,404 tons were completed, and work was suspended on 34,051 tons. Oil tankers of over 1000 tons under construction totalled 864,335 tons, which is 23,927 tons less than the previous quarter. World construction, totalling 1131 steamers and motorships of over 1000 tons gross, increased by 289,224 tons over last quarter, to 4,839,145 tons gross, of which 42·3 per cent is in Great Britain and Northern Ireland. Construction for countries other than the country of build was 1,645,952 tons, of which 50·2 per cent is in Great Britain and Northern Ireland. Of the world tonnage under construction, 40·8 per cent is accounted for by 181 oil tankers, of over 1000 tons gross, amounting to 1,974,675 tons, an increase of 97,626 tons over the previous quarter. Of the world tonnage 62·6 per cent, or 3,027,256 tons, are under the inspection of Lloyd's Register, 1,884,564 tons being built in Great Britain and Northern Ireland and 1,142,692 tons abroad.

Accidents on Railways During 1949

THE annual report of the chief inspecting officer of railways upon the accidents which occurred on the railways of Great Britain during 1949 has just been issued. This report shows that during last year no passenger was killed in a train accident, a record not achieved in this country since 1908. During the year under review, 1634 million passenger journeys were made, as against 1646 million in 1948; passenger mileage also decreased by 135 millions to 24,958 million miles. Total train mileage, however, increased by 4·1 per cent to 416 millions. The number of train accidents reported in 1949 was 1176, as compared with 1388 in 1948, and of these accidents twelve resulted in fatal injuries to persons other than passengers. In analysing these accidents, the report shows that no less than 594 resulted from the failure of the human element and 119 from defective apparatus. Failures of permanent way, structures and rolling stock continued to decline and totalled 4062, a figure well below the average of 4149 between 1935 and 1939. Of the forty-four passengers killed in movement accidents, as distinct from train accidents, thirty-eight lost their lives owing to falls from platforms and trains and when alighting or entering trains. Most of these accidents were caused by misadventure, carelessness or misconduct on the part of passengers themselves. Six people were killed in vehicles at level crossings and the report draws attention to the increasing risks at a large number of occupation level crossings, which have in the course of years assumed the character, but not the legal status, of public road crossings. Some forty-two accidents occurred at these occupation crossings during the year, as compared with sixty-five in 1948. Deaths and injuries among railway servants in all movement accidents on rail numbered 188 and 2625, respectively, and there were 123 fatalities whilst working, walking or standing on the permanent way on duty.

A Gas Grid for Rural Essex

THE first section of a gas integration scheme for Essex, which will eventually stretch from Colchester to Chelmsford, is now nearing completion by the Eastern Gas Board. The first 22 miles of main will enable a supply of gas to be given from the Colchester gasworks to Kelvedon, Witham and Braintree, where the demand has outstripped the capacity of the local works. One result of the scheme will be that gas will become available for use on farms and in villages en route, which were previously outside the range of any piped gas supply. The gas passing through the main, estimated at 350,000,000 cubic feet per annum to start with, will be pumped from Colchester at medium pressure, and later, when the load becomes heavier, the transmission pressures will be raised. Boosting plant transferred from the Ipswich gasworks will deal with immediate needs. The cost of the main and ancillary plant is expected to be in the region of £145,000. A feature of the first section of the scheme is that more than three-quarters of the length of the main has been laid across open country instead of along main roads, resulting in a substantial saving in costs, but involving the negotiation of forty-eight wayleaves and legal agreements. It is intended to extend the bulk supply system in 1951 to Maldon, where the existing works is too small to cope with growing demand. Finally, in 1952, the Board proposes to continue the main to Chelmsford, where a new vertical retort carbonising plant is now being erected.

International Association for the Exchange of Students

THIS week there has appeared the third annual report of the International Association for the Exchange of Students for Technical Experience. It gives an informative account of the progress made during the past year. One important development during the year has been the increasing number of countries, both in and outside Europe, which have either become members or are considering membership of the Association. The total number of students exchanged during the year was 1672, compared with 1236 last year, and in these exchanges twelve countries participated. But the report makes the observation that, in some countries, there is evidence that the possibility of enlarging the flow of students by making the services of the Association available to a greater number of universities and colleges has not been fully realised. In this country, it may be noted, the expansion of the central organisation has continued by the inclusion of students from six additional universities and colleges, the total number of such British establishments now taking part in the work of the Association being nineteen. The general secretary of the Association is Mr. J. Newby, Imperial College, South Kensington, S.W.7.

Advisory Committee on Ironstone Restoration

THE Minister of Town and Country Planning has now set up an advisory committee to assist him to carry out the policy on ironstone restoration which was set out in a statement in Parliament at the beginning of July last. In that statement the Minister said that, apart from a limited amount of afforestation, there was to be a complete restoration of land disturbed by ironstone working, with replacement of topsoil, except where the length of the working face would make the cost of replacing topsoil very high, or where the content of the overburden might make restoration to agricultural use impracticable. Sir Henry Prior, Controller of the North Midlands Region of the Ministry of Town and Country Planning, will serve as chairman of the committee, the other members of which are:—Mr. A. H. Waters, V.C., who was the author in 1946 of a report on "Restoration Problems in the Ironstone Industry in the Midlands"; Mr. D. Christy, of the Ministry of Agriculture; Mr. G. Alexander, M.I.Min.E., Board of Inland Revenue Valuation Office; and Mr. Cyril Watts, Chairman of the National Council of Associated Iron Ore Producers, with whom Mr. A. R. Hay, Vice-Chairman of the Council, will alternate. The general terms of reference of the committee are "to advise the Minister of Town and Country Planning on the after-treatment conditions to be attached, in particular cases, to permissions under the Town and Country Planning Act to win and work ironstone by opencast methods, and/or the additional expenditure likely to be reasonably incurred in complying with such after-treatment conditions."

Productivity in British Industry*

No. XV—SAFETY IN INDUSTRY

By SIR ALFRED HERBERT, K.B.E.

PART II—(*Continued from page 392, October 27th.*)

UNEXPECTED RELEASE OF MUSCULAR TENSION

This is a frequent cause of trouble. A common example is the use of an ill-fitting spanner, which slips off the nut and allows the arm, hand or elbow to come into violent contact with some nearby object, either stationary or in motion, causing cuts, abrasions or fractured fingers. Box spanners are relatively free from the danger of slipping and are always preferable to open-ended wrenches. A slipping screwdriver is liable to cause similar trouble, and it is surprising that even now many of us have not yet learned that the business end of a screwdriver should be parallel and not tapered.

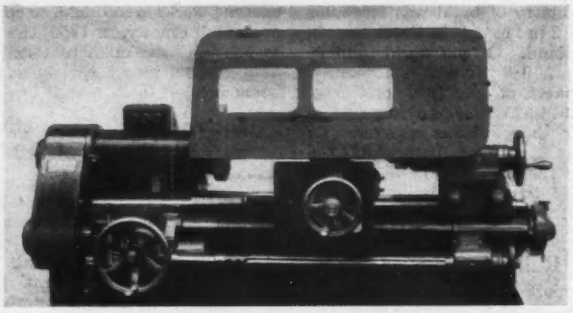


FIG. 15—SWINGING TRANSPARENT MACHINE GUARD

SWARF AND TURNINGS

The swarf produced by milling and drilling is full of needle-like spicules, which are eager to penetrate the skin and break off leaving a source of infection. Swarf should never be touched by the bare hands, but should be dealt with by metal rakes or brushes and never by cotton waste, which not only accumulates sharp splinters of metal and transfers them to the hands, but is particularly liable to entanglement in moving parts.

The high speeds at which metal is cut nowadays on capstan and turret lathes produces chips, all of which are dangerous. Some of them consist of small fragments coming off with the velocity of projectiles, always sharp and frequently very hot. It is necessary to provide adequate guards (Fig. 15) for which transparent materials are now available and the use of visors (Fig. 16) or goggles should be encouraged. Other cuttings consist of long snake-like spirals, which if they come in contact like clothing are liable to bore their way like augurs into the skin. Chip-breakers are now available, which cause these long turnings to be broken up into short and harmless pieces (Fig. 17). Men dealing with swarf removal as a regular part of their work should invariably wear substantial leather gloves.

SLINGS

Slinging a machine or awkwardly-shaped castings or forgings is by no means an unskilled job, though it is frequently undertaken without reasonable care. At best the machine, or the job, may be damaged, whilst at worst, the operator may be hurt. Slings should be regularly inspected and any which show signs of wear should be replaced or relegated to lighter jobs. It is often not realised that the strength of a sling depends on the angle of its parts. When these are parallel the safe load is much greater than when they are spread apart at an angle. A table giving working loads for good hemp ropes at various angles and emphasising the risks that may be run through carelessness in slinging will be found accompanying this article.

TABLE I—*Working Loads for Hemp Ropes*

Circumference of rope	Maximum safe working loads in tons and cwt											
	Single leg		Two legged sling at different angles									
			0 deg.		30 deg.		60 deg.		90 deg.		120 deg.	
in	tons	cwt	tons	cwt	tons	cwt	tons	cwt	tons	cwt	tons	cwt
1¼	—	1½	—	2	—	1¾	—	1¾	—	1½	—	1
1½	—	3	—	4½	—	4¼	—	4	—	3	—	2½
2	—	4	—	6	—	5½	—	5¼	—	4¼	—	3
2¼	—	6	—	9	—	8¼	—	7¾	—	6¼	—	4½
2½	—	8	—	12	—	11½	—	11¼	—	8½	—	6
2¾	—	10	—	15	—	14½	—	13	—	10½	—	7½
3	—	15	1	2	1	1	—	19	—	15	—	11
3¼	—	18	1	7	1	6	1	3	—	19	—	13
3½	1	0	1	10	1	9	1	6	1	1	—	15
4	1	2	1	13	1	12	1	8	1	3	—	16
4¼	1	4	1	16	1	15	1	11	1	5	—	18
4½	1	7	2	0	1	18	1	14	1	8	1	0
5	1	9	2	3	2	1	1	17	1	10	1	1
5½	1	13	2	10	2	8	2	3	1	15	1	5
6	1	16	2	14	2	12	2	7	1	18	1	7
6½	2	2	3	3	3	1	2	15	2	5	1	11
7	2	5	3	7	3	5	2	18	2	7	1	13
7½	2	10	3	15	3	12	3	5	2	13	1	17
8	2	17	4	5	4	2	3	14	3	0	2	2
8½	3	6	4	19	4	16	4	6	3	10	2	10
9	3	10	5	4	5	0	4	11	3	14	2	12
9½	3	18	5	16	5	12	5	0	4	2	2	18
10	4	4	6	6	6	2	5	9	4	9	3	3
11	4	16	7	4	6	19	6	5	5	2	3	12
12	5	8	8	2	7	17	6	16	5	15	4	1

ABRASIVE WHEELS

These have a very harmless look, but they are, in fact, among the most vicious things in a machine shop (Fig 18), inflicting painful and serious injuries on hands which come in contact with them. The workers' hands should never be brought near to an abrasive wheel while it is rotating, for an unexpected slip may involve grave results.

HAND TOOLS

The heads of cold chisels after long use are apt to become burred over (Fig. 19). These burrs frequently fly off under the hammer and cause injury to anyone in the neighbourhood. All chisel heads should be dressed periodically. A loose hammer head is a menace, which should never be permitted to exist. I remember the loose head of a striker's hammer flying off and lodging in his mate's mouth.

FIG. 16—PROTECTIVE VISOR FOR EYES

File and screwdriver handles are liable to split (Fig. 20) and the tang may inflict a serious punctured wound, which of all wounds, is the most difficult to cleanse and is almost certain to become deeply infected. Revolving shafts, even when apparently smooth, to say nothing of keyways, or splines, are always a danger and very liable to entrap clothing.

BELTING

On most modern machines belting is fully guarded. It should never be touched by the hand when in motion. This applies particularly to the in-going side of the belt.

OVERHEAD SUPPORTS

On capstan and turret lathes overhead supports constitute a source of danger which it is

* No. I, "An Introductory Survey," by B. White, appeared February 17th; No. II, "The Threshold of Productivity," by F. A. Martin, March 3rd; No. III, "High Productivity and Production Costs," by Sir Claude Gibb and Gordon M. Baker, March 17th; No. IV, "Standardisation in the Aircraft Industry," by E. C. Bowyer, March 31st; No. V, "Restrictive Practices," by Arthur Woodburn, April 21st; No. VI, "Research for Productivity," by Dr. D. F. Galloway, May 19th; No. VII, "Consequences of Simplification," by W. D. King and H. Sherburn, June 30th; No. VIII, "Works Extensions," by C. K. F. Hague, July 28th and August 4th; No. IX, "Mechanical Handling," by F. Garner and A. Siddall, August 11th and 18th; No. X, "The Importance of the Craftsman," by F. V. Everard, September 1st; No. XI, "Productivity in the Smaller Engineering Works," by Antony Vickers, September 15th; No. XII, "Productivity in Civil Engineering," by Lieut.-Colonel C. M. Norrie, September 29th; No. XIII, "The Measurement of Productivity," by L. H. C. Tippett, October 13th; No. XIV, "The Contribution of the Machine Tool Industry," by J. B. S. Gabriel, October 20th.

difficult to eliminate, and of which the operator should be fully aware. If, in a moment of inattention, a finger is placed either on the overhead supporting bar or on the bush which engages with it, it is inevitably crushed or amputated as the tool moves forward (Fig. 21). For some time we have, where possible, fitted all overhead supports with rubber protectors, which give warning by touching the finger before any damage is done, and the use of these or similar devices should be insisted on.

Drilling machines are by no means free from danger. Small jobs on the table of drilling machines, unless definite stops are provided, may suddenly start to rotate violently if the drill is overfed or seizes.

Starting and Stopping of Machines

One of the first things that an operator should learn is how to start, and particularly how to stop, his machine in an emergency, and it is desirable that he should also know how to stop his neighbour's machine, for a man may be involved in an accident which prevents him from stopping his own machine and is, therefore, dependent on the immediate action of someone else.

Portable Electric Tools

These need care and attention. The most important precaution is to ensure that the portable tool is properly "earthed." With single-phase tools the flexible cable should be 3-core and coupled to a 3-pole socket; the latter being properly earthed. The continuity of the earthing throughout should be tested periodically as it may fail without the failure being detected. Electric tools are usually coupled to a 3-pole plug; if the customer has an old-fashioned 2-pole socket installation, he should change the socket and earth it and not take the easy way out and change the plug. An isolating switch should be installed near each socket and the operator should switch off before inserting or removing the plug. There are now available a number of combined sockets and switches arranged so that it is impossible to insert or withdraw the plug until the switch is in the "off" position, and the use of these is strongly recommended. Special care should be taken in buildings having stone or concrete floors, particularly if damp, as this would expose the operator to a more severe shock than on a dry or wood floor.

Fig. 17—"Chiprupter" in Operation

Fig. 18—Result of Improper Use of a Grinding Wheel

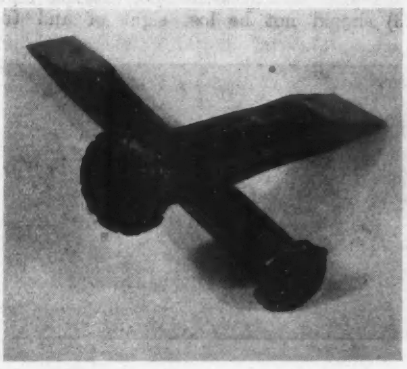


Fig. 19—Mushroom Headed Chisels

Flexible Cable

This should be treated with respect (Fig. 22) and should be examined carefully where it enters the drill and the plug. Cables should not rest on the floor where trucks or feet may damage them. If the tool will not reach the job, do not try to stretch the cable; this will certainly damage the installation.

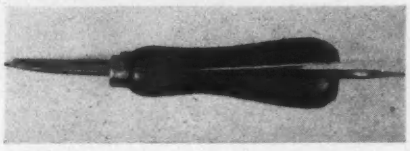


Fig. 20—Tang Projecting Through Handle of Tool

Accident Investigation

When an accident is fully investigated and, if necessary, as the French say "re-constructed," the almost invariable verdict is that, given care, thought and a reasonable measure of common sense, the accident should never have happened. But foresight is notoriously much more difficult than hindsight, as witness the proverb about the uselessness of being wise after the event. But the proverb is at least only partially true, for

Fig. 21—Unprotected Overarm Support

the lessons learned during the investigation of one accident may, if intelligently applied, lead to the prevention of similar happenings in the future.

In order that accidents (for example Fig. 23) should not be lost sight of and to

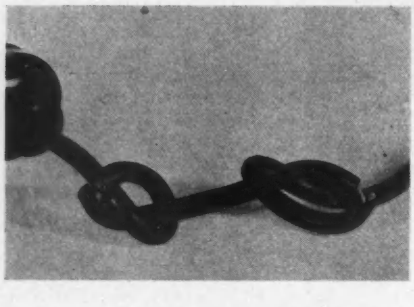


FIG. 22—MALTREATED ELECTRIC FLEX

ensure that they may be treated as lessons for the future, it has long been the practice for our safety officer to report all accidents with the relevant parti-

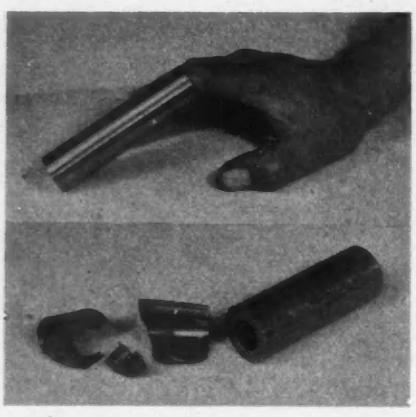


FIG. 23—RESULT OF FINGER PLACED IN REVOLVING THREADER BUSH

culars. These reports are investigated by a small committee, including the safety officer, the foremen of the departments concerned, the chargehands and frequently the victim himself, while the works director or works manager is usually present. These reports, with any further information that is revealed during the investigation are submitted to me and subsequently returned to the safety officer with any notes or criticisms that may occur to me. I have found that this procedure has valuable results in keeping us alive to the dangers which beset our people.

It is a very cheering sign of the times that interest in industrial safety is continually growing. A conference at Scarborough in May dealt very fully with this subject. In Coventry, the Employers' Federation, in conjunction with the local safety group, and with the full support of local employers, recently held an Industrial Accident-Prevention Exhibition (Fig. 24), which attracted a great deal of interest and which was attended by a large number of people. It is hoped that other industrial areas may also hold similar exhibitions and that they will not hesitate to ask Coventry for loans of interesting items, which will very gladly be supplied.

Many years ago a most valuable Safety Museum was established by the Home Office in Horseferry Road, Westminster. It is still open to the public and is well worth a visit from managers, safety officers and workers and this institution will also lend anything suitable for display in local exhibitions.

When anyone undertakes to write an article or to give a lecture on any subject, it is generally true that he himself derives more information through the process of preparation than any of those who read his article or hear his lecture. This is my own experience. While compiling these notes I am left with a very real fear that in attempting to remove motes from the eyes of other people, I may very probably have overlooked many beams in our own.

Omelettes cannot be made without breaking eggs, nor can industrial operations be carried on without some accidents, but I confidently believe that by constant and sustained interest their incidence can be greatly reduced.

In conclusion the following figures from our records may be interesting and not without encouragement, showing as they do a marked improvement over the last five years. But satisfaction is still a long way from attainment.

Classification of Accidents

	1944			1949		
	Number of Accidents	Number of Employees	Percentage	Number of Accidents	Number of Employees	Percentage
Planers, Shapers and Slotters	10	69	14·5	5	61	8·2
Heat treatment	6	68	8·8	3	52	5·8
Foundry (moulders, casters, furnacemen and coremakers)	9	94	8·5	9	109	8·2
Lathe operators	55	609	8·2	25	417	6·0
Fitters	58	732	8·0	21	684	3·0
Transport	4	57	7·0	2	98	2·0
Drillers	11	170	6·4	4	145	2·7
Gear cutters	4	63	6·4	1	35	2·8
Labourers	68	1139	6·0	28	547	5·1
Millwrights	7	116	6·0	9	104	8·6
Grinders	37	659	5·6	9	417	2·1
Cutting off	1	23	4·3	Nil	16	Nil
Miscellaneous (Blacksmiths, Fettlers, Police, Clerks, Canteen, &c.)	15	591	3·9	9	799	1·1
Millers	18	486	3·7	8	309	2·6
Borers	1	32	3·1	Nil	44	Nil
Inspection	7	513	1·4	5	406	1·2
Pattern makers and joiners ...	1	74	1·3	3	99	3·0
Painters	—	23	Nil	2	101	1·9
	312	5518	5·66	143	4443	3·2

Types of Accidents

	1944	1949
Foot Injuries	66	27
Eye injuries	22	10
Strains and sprains	20	14
Hernia	2	2
Slipping and falling	27	18
Spanners and screwdrivers slipping	9	1
Contact with grinding wheels	16	5
Trapped fingers	51	12
Loose clothing	2	2
Sepsis	11	5
Sepsis, due to neglect	10	nil
Cuts, handling work, tools and swarf	41	33
Burns, scalds and electrical injuries	6	5
Miscellaneous	29	9
Total	312	143

FIG. 24—INDUSTRIAL SAFETY EXHIBITION AT COVENTRY

THE FRASER AND CHALMERS ENGINEERING WORKS of the General Electric Company, Ltd., has received an order for a 100 tons per hour capacity, heavy-media separation plant for treating manganese ore in West Africa.

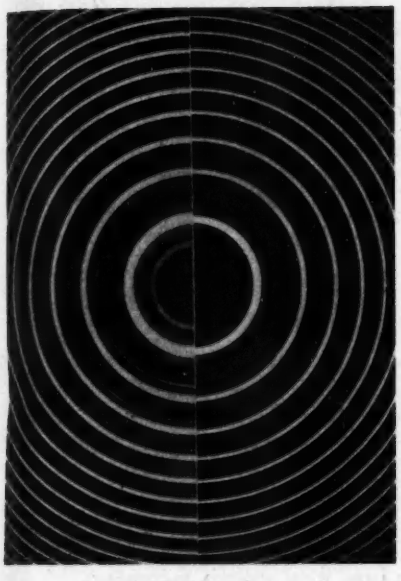
ELECTRICAL POWER OVERSEAS.—Developments in electrical engineering overseas formed the theme of three films that were included in a film show presented recently in London by Enfield Cables, Ltd. The first film, "Water Power, Eternal Power," showed how Switzerland, a small country with no seaboard and few indigenous raw materials, depended upon water power for her industrial output. In 1948 Switzerland generated 2250kWh per head of her population (more than any other country, except Norway and Canada), the corresponding figures for the U.S.A. and Britain being 2140kWh and 1000kWh respectively. The second film showed some of the problems that had to be solved in the construction over forest and marsh of the 380kV transmission line from the North of Sweden to the industrial centres in the South. Finally there was a film giving some of the stages in the construction of Shipshaw 2 power station, near the Arctic Circle in Canada. The 1200MW station was built in only two years, during the recent war, to supply the world's largest aluminium plant at Arvida, Quebec.

Mercury and Krypton Isotope Electric Discharge Lamps

THEIR APPLICATIONS TO INTERFEROMETRY

By N. L. HARRIS, B.Sc., F.Inst.P.*

ADVANCES in nuclear physics and the development of the atomic pile have led to new techniques in the artificial production of isotopes of elements. Other developments have taken place recently in the methods of separating a single isotope from the mixture of those which occur in many elements in their natural form. Two particular developments have been the synthesis of the isotope of mercury of mass number 198 and the separation of the krypton isotope of mass number 84. The spectra of both these isotopes have been excited in certain special types of experimental electric discharge lamp



(Mirror separation 5·5mm)
Left half: natural mercury. Right half: Mercury 198.

FIG. 1—FABRY-PEROT FRINGES IN MERCURY GREEN LIGHT

and have been applied to various interesting developments now taking place in the exact measurement of length by the methods of optical interferometry.

When two beams of light derived from a single source, but having different optical path lengths, are recombined to form a single beam, an interference pattern of dark and light fringes is formed. The most extensive patterns are obtained when monochromatic radiation is used, although the limited fringe patterns produced by white light are sometimes introduced to provide reference points. The separation of each of the fringes from its neighbour in the interference pattern corresponds to an optical path difference of a half wavelength of the monochromatic light used. Since the wavelength is generally known to a very high order of accuracy (e.g., that of the red line of cadmium is known to be 6438·4696 Ångstrom units), a difference of path length can be determined very exactly by counting the number of fringes in the patterns or by estimating the displacement of one system of fringes in relation to a reference system. If the two optical paths are associated with an unknown length (e.g., by reflection from the end of a gauge block which requires to be calibrated, and also from the face of an optically flat plate to which it is "wrung") this unknown length can be determined in terms of the wavelength of the light used.[1] Interference patterns have also been employed to measure minute imperfections of a polished surface in an "interference microscope," such as that described recently in this journal.[2] Similar optical principles are also used in the setting up of interferometers employing a large field of view.

Apart from such practical engineering applications, the accuracy attainable in length measurement by interference methods will lead in the near future to the definition of the international standards of length in terms of light waves. They have already been provisionally specified in terms of the wavelength of the cadmium red line. Extensions of the methods will result in a direct determination of length by these means over distances as great as 1 yard or 1m.

Clearly the accuracy attainable in all such work depends upon the sharpness of the fringes and this, in turn, is related to the purity of the spectral line chosen for use. The closer this line approaches to the ideal of radiation of a single frequency, with a negligible spread of frequency and an absence of hyperfine structure, the better is the result. There are various causes of this undesirable complexity in a spectrum. One of these, of

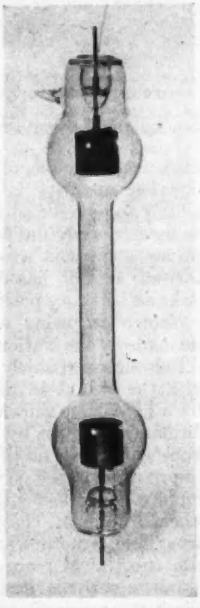
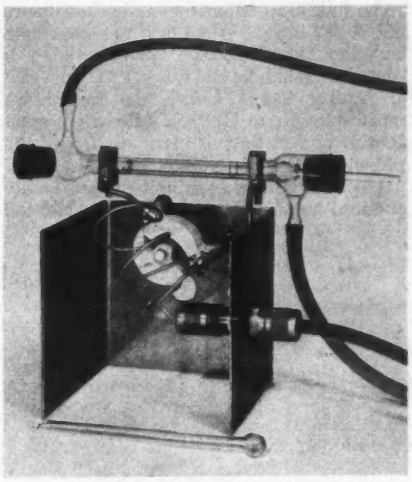


FIG. 2—MERCURY^{198} ISOTOPE DISCHARGE LAMP

fundamental importance, is the presence of isotopes in the element whose spectrum is being used. Many elements in their natural form have been found to consist of a mixture of isotopes; that is to say, of differing atomic weight, inseparable by normal chemical means, but characterised by certain important differences in physical properties amongst themselves. The atoms of each isotope, for example, will have their own characteristic frequency of radiation in the spectrum of the element and the more isotopes there are, the broader and more complex will be the spectral lines. Furthermore, the effects produced by nuclear rotation of the atoms of a single isotope (which the spectroscopist refers to as "spin") introduce complexities in the lines. Atoms of odd mass number have a resultant "spin" and show greater complexity than those of even mass number, in which the spin components cancel out. Theory predicts that a single isotope with an even mass number, of a heavy element, will give the sharpest lines and experiment has proved the truth of this proposition. The improvement in sharpness of fringes which can be achieved in this way is shown in Fig. 1, reproduced by courtesy of the Director of the National Physical Laboratory, Teddington.

The fringes systems shown in this example were obtained from a mercury spectrum using the line of 5461 Ångstrom units wavelength. The mercury spectrum is often employed in optical work and forms an attractive source of radiation for many appli-



The Tube is shown mounted in a water cooling jacket and fitted into the R.F. coupling unit. The discharge tube itself is shown in the foreground.

FIG. 3—R.F. EXCITED MERCURY^{198} ISOTOPE DISCHARGE LAMP

cations. It is easily excited in an electric discharge and its structure is comparatively simple, with a number of bright lines well spaced throughout the entire visible spectrum. Natural mercury, however, is a mixture of seven isotopes, whose mass numbers and relative abundance are shown in Table I.

TABLE I
The Isotopes of Mercury

Mass Number	196	198	199	200	201	202	204
Relative abundance	0·15	10·1	17	23·3	13·2	29·6	6·7

When several isotopes occur with similar abundance they may not be easily separable by physical processes, but it has proved possible to produce the Hg^{198} isotope artificially, and relatively easily, in the atomic pile.

THE ARTIFICIAL PREPARATION OF Hg^{198} ISOTOPE

The process used has well been described as "alchemy in reverse," for, whereas the alchemists of old sought to transmute mercury into gold, the process now used for

* Research Laboratories of the General Electric Company, Ltd., Wembley, England.

producing Hg^{198} transmutes gold into mercury by bombardment with neutrons in the interior of the atomic pile. The nature of the process is summarised as follows:—

$$^{79}Au^{197} + {}_0n^1 \rightarrow {}^{79}Au^{198} \rightarrow {}^{-1}\beta^0 + {}^{80}Hg^{198}$$

The nucleus of an atom of natural gold, of mass number 197, takes up a neutron, and an atom of gold of mass number 198 is produced. This artificially synthesised Au^{198} is radioactive, and by the emission of an electron from the atomic nucleus it is transformed to the mercury Hg^{198} isotope, which is stable.

The process is carried out by sealing gold foil in an evacuated quartz tube, which is placed inside the atomic pile for some weeks. During this time about one hundred-thousandth of the mass of gold is converted to Au^{198}, i.e., 10g of the gold foil will then contain 0·1mg of the artificially produced radioactive Au^{198}. If the process is unduly prolonged, Hg^{199} will also be produced by the absorption of an additional neutron in the nuclei of some of the artificially produced mercury atoms, which is undesirable. The practicable limit is probably not yet known accurately, and further experience may permit the production of some ten times the present amount of Hg^{198} in a given quantity of gold.

The half-life of the radioactive isotope of gold is 2·7 days. When first removed from the pile, therefore, the quartz vessel is dangerous to handle and it is left to "cool off" for several weeks before the radioactive transformation to Hg^{198} is sufficiently complete to permit further manipulation of the gold without protective measures.

It is then possible to distil the artificially produced mercury isotope from the gold foil

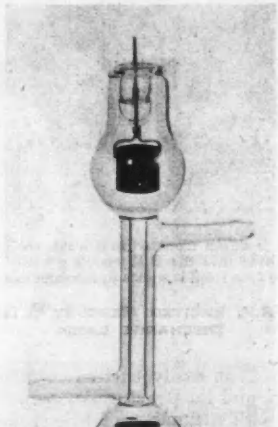


FIG. 4—WATER-COOLED POSITIVE-COLUMN MERCURY^{198} ISOTOPE LAMP

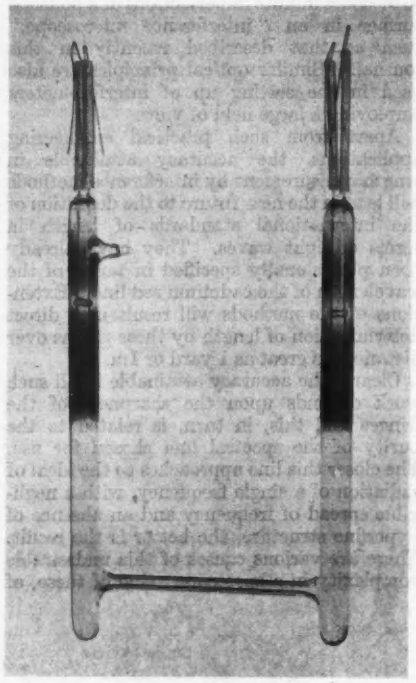
by heating the quartz vessel to a high temperature, and the mercury which is driven off in this way may be transferred to the discharge tube in which its spectrum is to be excited.

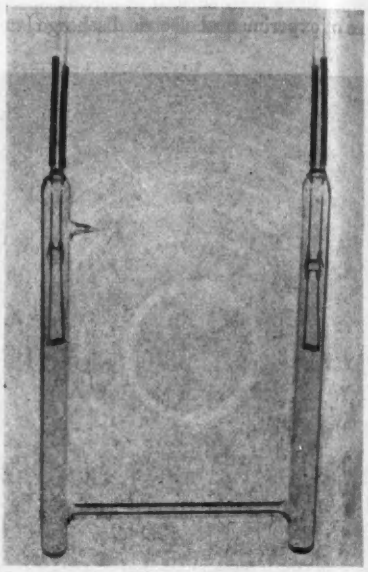
Hg^{198} Isotope Lamps

Two types of discharge tube have been used in this country. One of these (Fig. 2) is a modified form of Geissler tube, in which the current passes between metal electrodes at the ends of a narrow glass tube in which a "positive column" electric discharge is excited. The second type (Fig. 3) is an electrodeless tube in which the discharge is excited by a radio frequency generator coupled externally to the tube.

Meggers[3] (in U.S.A.), who developed the use of Hg^{198} in discharge tubes, has favoured the electrodeless variety. In this country development work at the research laboratories of the General Electric Company, Ltd., Wembley, has revealed some interesting possibilities in tubes equipped with electrodes.

These two different directions of development are influenced to some extent by differences in availability of the mercury isotope in the two countries. The American





The blackening around these lamps is produced deliberately during the final ageing and purifying of the filling.

FIGS. 5A AND 5B—KRYPTON^{84} ISOTOPE LAMPS WITH HEATED ELECTRODES

electrodeless tube required 3mg of Hg^{198} and, although a smaller quantity is now being used, it is unlikely to be reduced to less than 1mg. In this country only limited amounts of the isotope are at present available from A.E.R.E, Harwell, and it has been found possible to make satisfactory positive column tubes, with electrodes, using as little as 0·1mg. Tests made by the National Physical Laboratory Teddington (which is closely associated with the G.E.C. in this development), and by others, have shown that satisfactory performance is given by tubes with electrodes, from which a useful life of several hundred hours may be expected. The electrodeless form of tube is also being studied to decide whether American claims that it yields a sharper line structure are justified There is little theoretical reason why this should be so unless, perhaps, it should prove possible to eliminate gaseous impurities more completely in this form.

Apart from the great reduction in the quantity of Hg^{198} required in the positive column tube, the latter offers decided advantages in the simplicity of its operating circuit. A simple leakage-reactance type of transformer operating from a.c. mains to provide 500V, 25mA is all that is needed. The electrodeless tube, on the other hand, requires a relatively elaborate push-pull valve oscillator, generating power at 100 Mc/s or more. Below this frequency a decided reduction in tube brightness occurs, and there is a greater tendency for the mercury to disappear during operation of the tube. Jacobson and Harrison,[4] other American workers in this field, claim advantages in brightness for a considerable increase in frequency above this value.

If the Hg^{198} tube should ultimately be adopted for defining the international standards of length, the simplicity of the operating circuit of the positive column type of tube may well have significant advantages and permit a greater accuracy in specifying the operating conditions of the light source, which is of great importance in defining a standard.

It may be of interest to note certain other factors which influence the performance of these light sources. The temperature of the tube in operation controls the vapour pressure of the mercury and influences the sharpness of the lines in the spectrum radiated. This effect is described in greater detail later. It has been found advantageous, when the utmost sharpness is required, to provide a water jacket for cooling the column, as shown in Fig. 4. A rare gas filling is required to initiate and sustain the mercury discharge, and neon and argon have both been used for this purpose. The former has the disadvantage that if the tube is watercooled the operating current must be reduced, and the brightness diminished in consequence, if intrusion of the neon spectrum is to be avoided. The use of argon has resolved this difficulty. The presence of the rare gas produces a minute, but significant, alteration in the wavelength of the mercury lines. This amounts to approximately 1 unit in the eighth significant figure per millimetre pressure of gas filling.

During the operation of either type of tube the mercury tends to disappear. In the electrodeless form it is taken up by the envelope, which darkens in the process. This mercury is recoverable and the envelope clears when the tube is heated to a high temperature. In the positive column type, the electrode material tends to sputter during life and to be deposited as a dark, metallic film at the ends of the tube. This does not obscure light output but the mercury

tends to be absorbed in the film. There is evidence that it can be recovered by baking the tube as in the electrodeless type.

The effect of temperature on the performance of the light source has been mentioned. Mercury lamps operating at normal temperatures exhibit the Doppler effect, which causes a slight broadening of the spectrum lines, due to the random translatory motion of the atoms of mercury vapour in the discharge. The radiation from those approaching the observer is apparently increased in frequency compared with those at rest. Similarly, those moving away from the observer appear to have a lower frequency. The effect, though slight, is significant and it can be lessened if the temperature of the radiating gas or vapour is substantially reduced, for example, by immersing the tube in liquid air. This is impossible with a mercury discharge in which the vapour pressure of the mercury would then fall far below a value capable of sustaining a discharge. With a rare gas such as krypton, this extreme cooling is, however, practicable.

The Use of the Krypton Discharge

There are extremely interesting possibilities in the use of a krypton discharge for interferometric work. Its spectrum, although more complicated than that of mercury, is not too complex to be useful. Krypton is composed of six isotopes, whose mass numbers and relative abundance are shown in Table II. The high proportion of the Kr^{84}

Table II

The Isotopes of Krypton

Mass Number	78	80	82	83	84	86
Relative abundance ...	0·34	2·2	11·5	11·5	57·0	17·4

component makes it possible to consider separation rather than synthesis of this isotope, which, being of even mass number, is eminently suitable for use in interferometry. An outstandingly ingenious solution of the practical problems involved in this separation process has been found by Dr. J. Koch of the Universitetets Institut for Teoretisk Fysik, Copenhagen.[5]

In his method, the Kr^{84} isotope is isolated in a mass spectrograph by separation of ionised krypton in a powerful magnetic field. The various isotopes follow different curved paths within the instrument, the radius of each curve being related to the strength of the field and the mass of the isotope. By suitable adjustment, the Kr^{84} atoms are all focused on to a slit, through which they pass. They are then adsorbed on the surface of a slowly moving strip of aluminium foil, which is wound into a cylindrical coil as the process proceeds. Although the quantity of Kr^{84} which can be prepared at present is extremely limited, appreciable amounts of the isotope have been collected in this manner and, somewhat unexpectedly, it has been found possible to store the aluminium in a glass vessel, in air, for periods of several weeks and then to recover the isotope as a gas by heating the foil. The latter is placed in an evacuated vessel joined to a discharge tube, which can ultimately be sealed off with a filling of pure Kr^{84}. In this way several tubes of the type shown in Fig. 5 have been produced at the Research Laboratories of the General Electric Company, Ltd., with Kr^{84} prepared several weeks previously by Dr. Koch in Copenhagen.

The quantity of gas (at S.T.P.) adsorbed on the aluminium foil amounts to some 10^{-3} to 10^{-4} ml per square centimetre. Discharge tubes have been prepared containing only the krypton isotope, but it appears to be equally satisfactory to use an auxiliary filling of helium gas as an exciter and to economise considerably in the amount of Kr^{84} required for each discharge tube. As little as 0·1mm pressure of Kr^{84} has provided a satisfactory result. Various tubes of this type (Fig. 5) are being studied at the National Physical Laboratory, Teddington, and elsewhere.

Of the various tubes described in this brief account of current developments, it remains to be proved which types will prove most successful in the numerous fields of application of interferometry. For many purposes there is no doubt that the tube with electrodes and the simple transformer operated circuit will be satisfactory, and this will allow for the greatest economy in the use of the small amount of Hg^{198} available here at present. In the highly refined techniques involved in applying interferometry to the definition of standards of length, the utmost purity of spectrum lines will be essential. Theoretically there is little to choose between the mercury and the krypton spectrum for this purpose but, from a practical point of view, the mercury lamp shows advantages at present because of the ease with which the mercury isotope can be produced in an extremely pure form and the simplicity of the spectrum which it yields. Experience will decide whether the electrodeless form of tube will prove superior to the other form, where the utmost precision is essential. Further work is contemplated on a third type of mercury tube, using a cathode of special design, which can be immersed in liquid air. If it proves possible to excite the mercury spectrum satisfactorily within this electrode, the sharpness of the lines produced should be characteristic of a very low temperature spectrum, with a minimum of the Doppler effect, and superior to that which can be achieved at normal operating temperatures.

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[3]W. Meggers, "A Light Wave of Artificial Mercury as the Ultimate Standard of Length," *J.O.S.A.*, Vol. 38 (1948), page 7.

[4]E. Jacobsen and G. Harrison, "Ultrafrequency Excitation of Hg^{198} Lamps for Interferometer Illumination," *J.O.S.A.*, Vol. 39 (1949), page 1054.

[5]J. Koch, "Mass Spectrographic Separation of Isotopes of Gaseous Elements," *Nature*, Vol. 161, No. 4093 (1948), page 566.

The Salvage of H.M.S. "Breconshire"

(By our Naval Correspondent)

A FINE piece of salvage work has recently been completed by Admiralty salvage experts in raising the former merchant ship H.M.S. "Breconshire," which had been lying for eight and a half years in Marsa Xlok, a bay in Malta, about a mile off shore, in 60ft of water. An unusual ship of 9600 tons, the "Breconshire," formerly of the Glen Line, was a tanker forward of the engine-room and a normal cargo vessel abaft it, and was thus ideally fitted for carrying ammunition, aviation fuel, food and oil. She was hit in the engine-room by a bomb in 1942, after surviving many sustained aircraft attacks during her trips carrying supplies to Malta, and though H.M.S. "Penelope" succeeded in towing her to the shelter of the island, she had to be abandoned and sank two days later following further aircraft attacks which set her on fire. Subsequently, as she lay on the bottom with her side above water, a party climbed on to her, cut a hole in her side and pumped out 1000 gallons of oil for the Malta garrison.

Three salvage vessels, under Captain O. T Harrison, Chief Salvage Officer for the Boom Defence Department, in the R.F.A. "Sea Salvor," and a team of eight divers raised the vessel in the face of great technical difficulties and hazards. She was lying right over on her port side at an angle of 85 deg. from the vertical, and there were bombs and other explosives still in her holds. Her flooding valves were open and five plates were missing from her starboard side. When the first survey was made in April, 1949, it was estimated that it would take four years to clear her from the fairway, but by careful planning and the use of a 12ft scale model the salvage work has gone forward with far less expenditure of manpower and equipment than was originally anticipated. The initial work of salvage started in April of this year with the cutting away of 700 tons of superstructure and was completed on August 14th, when the vessel rose gently to the surface, bottom up.

The weight of every plate in the ship had been calculated and also the amount of air which could reasonably be pumped into the wreck to give her buoyancy. After many weeks' work, Captain Harrison decided that the best method of moving her was thus to allow her to turn over on her back and float in that position. This deduction was confirmed by the behaviour of the 12ft model which accurately reproduced the conditions and was floating in a tank with a sandy bottom reproducing the sandy conditions in the bay. The team of eight divers first of all had to enter the ship at her awkward angle of heel. To close the flooding valves they had to enter a 3ft cofferdam feet foremost and make their way along it to a space near the double bottom of the ship. This they did in complete darkness, for, owing to the thick oil still trapped in the vessel, no lighting could prove effective. Having reached the valves and closed them they had to make their way out head foremost, the space being inadequate for them to turn. The original plates blown from the "Breconshire's" sides when the bomb struck the engine-room were taken ashore, rolled flat and replaced by the divers with joints that were not only watertight, but airtight.

Divers were working as much as five hours a day and some of them had to spend six hours in compression chambers. Sometimes the divers discarded their heavy suits and dived naked with the aid of respirators attached to tubes. They emerged on these occasions covered in black oil. When using oxy-acetylene cutting apparatus on the oil compartments, numerous blow-back explosions occurred, due to the combination of the oxygen from the torch with the oil in the tanks. Special care had to be taken to avoid touching off the ammunition still in the ship. Some forty air connections had to be fitted under water, and, owing to shortage of gear, many of the air connections were improvised from ordinary household taps. No lifting wires were used and no pontoons, the principle being to render the ship herself buoyant by blowing compressed air into her, the classical salvage method.

With three salvage ships standing by, the "Sea Salvor," the "Dispenser" and the "Retrieve," their compressors all coupled to different sets of tanks through compressed air lines, blowing started on Monday, August 7th, in the double bottoms and went on throughout the night. On Tuesday, bad weather carried away some of the blowing lines. However, on the next day, the oil tanks were blown. It had been arranged that she should rise by the bows and turn over on her back at 1.30 p.m. In fact, during the morning her bows lifted and she pivoted over on her stern from her 82 deg. through the vertical, finally coming to rest at 25 deg. from the vertical, with her stern still on the bottom. It had been intended to tow her out to sea clear of all ship anchorages and sink her, but when it was discovered that she was a fully buoyant hulk and stable, an offer was made to buy her by a private firm in Malta, who planned to take her through the Messina Straits to Genoa. This offer was accepted and the hulk was handed over.

THE ENGINEER

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NOTICE TO READERS

All letters intended for insertion in THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

No undertaking can be given to return drawings or manuscripts; correspondents are therefore requestrd to keep copies.

For Subscription Rates, see page 2 of Advertisements.

"PEACE BE WITHIN THY WALLS"

THE dispute in the printing trade between the London Master Printers' Association and one of the printing unions, the London Society of Compositors—a dispute which has very seriously affected for the past few weeks the production of trade, technical and certain other publications in the London area, including THE ENGINEER—now appears to be within sight of settlement. The two parties to it are already in active negotiation for a new agreement, and—it is good news for all—the printers' men went back to work last Wednesday. Unfortunately, that was a day too late in the week to permit this to become a full-sized issue. Only a very few extra pages could be printed. Next week's issue, however, will indicate by its size that printing is back to normal. Indeed, since in producing it we shall not be hampered by certain restrictions imposed by the union as far back as last May and kept in force ever since—save only for one very brief period—we hope that forthcoming issues will be larger than ever since the end of the war.

For want of the work of the compositors we have been unable in the last few attenuated issues to print much material about topical events of interest to engineers. But, lest the dispute in the printing industry continued, we had made plans to overcome that difficulty. Accompanying this issue there is a Supplement. It will be found upon examination to amount to a special emergency number of THE ENGINEER. In its editorial section there appears some of the more topical material we expected to be unable to print in the issue; and that editorial matter is accompanied by "classified" advertisements. That Supplement was prepared, put together and printed by a process independent of the services of our printer's men. Had not the dispute in the printing trade been sufficiently settled to permit the printers to return to work this week a similar Supplement would have appeared each week "for the duration." It is true, as readers will observe, that in appearance and in readability such Supplements could not have reached the standard set in our ordinary issues. Yet they would have allowed us—indeed, in the event of any future dispute they will allow us—to present to our readers material that we could have issued in no other way. The experience of producing one of them has certainly not been without its value.

It remains for us to congratulate the London Master Printers' Association and the London Society of Compositors upon reaching an agreement. But we do so with caution. For we cannot yet forget that during the "alarums and excursions" of the past few weeks work was once before restarted. But in the outcome, the dispute flared up soon afterwards in greater fury than before. It still needs emphasis, therefore, that the settlement so far reached is sufficient only to allow work to restart. The terms of the final settlement have still to be negotiated by the parties concerned in the light of the recommendations of the Court of Inquiry that recently examined "the causes and circumstances" of the dispute. However, it now seems very probable that agreement will this time be reached. Moreover the provision has been made in the present temporary settlement that if any difficulty does arise in the main negotiations it shall be submitted to independent arbitration. It is our hope, as it is the hope of all other journals affected by the dispute, that the settlement finally reached will be one which will remain valid for very many years to come; and one, moreover, that, directly or indirectly, will lead to similar long-term agreements with the other unions in the printing trade, not only within the London area, but over the whole country. For only thereby can peace be brought to an industry that has been kept in a constant state of unrest for over three years by the "leap-frogging" demands of individual unions. Thereby, editors, printers and printers' men will be enabled to make a return to that confident co-operative and friendly relationship, which existed before the recent troubles began and which all concerned will wish to exist again. We say to the printers, masters and men alike, "Peace be within thy walls," for then there will be "prosperity within thy palaces."

SAFETY AND PRODUCTIVITY

IN this issue there is concluded an article by Sir Alfred Herbert on "Safety in Industry." It may seem odd to some of our readers to find that article included in a series devoted to "Productivity in British Industry." For many engineers will call to mind certain safety requirements that appear at first sight to hamper rather than to help increased productivity. Yet further study will, we think, convince them that the apparent oddity is in fact unreal. Sir Alfred quotes figures that go some way to show how much the occurrence of accidents impedes production. During 1948 there were 201,086 notifiable accidents (861 of them fatal) at premises subject to the Factories Acts. What proportion those figures bear to the sum total of all accidents in industry it is not possible to say. It is, however, certain that the real total of all such accidents each year is well above the official figure. Every accident, however small, necessarily involves some loss of a worker's time; and some of them—more particularly those in which a worker was killed or maimed for life—account for a large loss of working time. Moreover if the worker involved happens to occupy a "key" position his temporary absence, whether short or prolonged, necessarily has bad effects upon production schedules. There is, too, a further point which Sir Alfred in his humane concern to preach the gospel of safety, does not discuss. Any engineer who has been present in a shop when a serious accident has occurred will have noted by how much the whole output of the shop for the day concerned is affected by such an event. The affair has to be talked over. News has to be spread of the occurrence and what was done about it. A curious morbid streak in human nature makes many seek some excuse to visit the place where the accident occurred. Nor is the influence always confined only to the day of the event. If it appears that the accident was the consequence of the failure of some item of plant such as, for example, a crane rope, there may be criticism of, and some failure of faith in, the ability of the management. It may lead to more permanent reduction of output lasting many days if not weeks. Thus even were it possible to imagine a management wholly indifferent to human suffering that management would still find it profitable to pay attention to the safety of its workpeople.

Yet what a difficult problem it is to find the means of reducing the number of accidents! Let anyone consider the examples of recent accidents that Sir Alfred quotes. Of how few is it possible to say that there is anything new or unusual about them! The fact is that much the same accident—save that different individuals are involved—is repeated again and again, month by month and year by year; and unfortunately is just as likely to occur again in the future as in the past. Yet many of those accidents could be prevented by such simple means as the wearing of stronger boots, of leather spats, of goggles or of more tightly fitting clothing; and many of them in retrospect are seen to have been the consequence of a careless disregard for obvious danger. Mankind, it seems, is perpetually ready to take chances and men remain for ever convinced that tragedy is something that afflicts others rather than themselves! Yet even as we deplore this foolish human trait can we not see also a misguided magnificence in it? For risks have to be taken in life. The proverb "nothing venture nothing win," is still as true to-day as it ever was. We cannot therefore wholly deplore man's neglect of "Safety First." Else should we have also to deplore Scott's fatal adventure to the South Pole and

the courage of the "Few" who saved Britain in 1940! And can a nation produce such men without also generating, in larger numbers, others as willing to take risks as they, though less competent to weigh the possible gains against the risks they take? Indeed, is not a willingness to accept risks an essential ingredient in human nature? Without it could man ever have gained that mastery over nature that has made him, above all other beasts, lord of the earth?

Must we then, in face of an ineradicable human quality, abandon hope of reducing the number of accidents in industry? Surely not! To take risks when little or nothing is to be gained thereby may be magnificent but is certainly foolhardy. Let that point but be preached loudly and continuously enough and only the stupid will fail to be convinced of the folly of taking risks unnecessarily. Moreover, there is a more positive means of preventing accidents that can often be applied. We can cover in all dangerous moving parts. We can devise guards such as those used on presses, that make it impossible for human hands to be caught in the machinery. We can arrange that when covers are opened circuits are broken and machinery brought to a stop. Such measures are peculiarly effective in preventing accidents since they allow little scope for the play of human frailty. Where they can be applied they should be applied. For even if, upon the shorter view, they appear to impede production, in fact, safety and productivity run in double harness. Other things being equal the safer factory will have the higher productivity. It is not therefore paradoxical to include an article on safety in a review of "Productivity in British Industry."

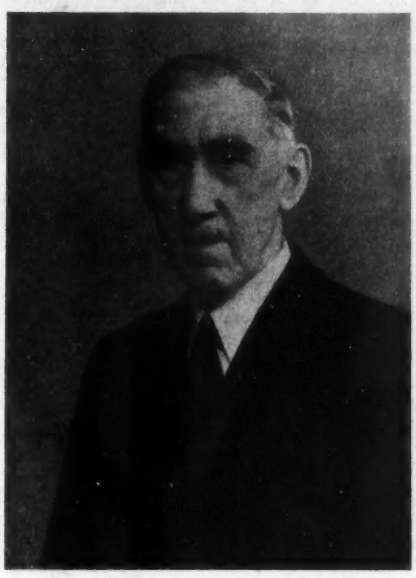
Obituary

SIR FRANK GILL

We regret to learn that Sir Frank Gill, K.C.M.G., O.B.E., who was a past President of the Institution of Electrical Engineers, died in Geneva on October 25th, aged eighty-four years, while attending meetings of the International Consultative Committee on Telecommunication (C.C.I.F.). A contemporary and friend of Alexander Graham Bell and Oliver Heaviside, Sir Frank was a pioneer in the development of telephony in Britain and internationally.

Frank Gill was born on October 4, 1866, at Castletown, Isle of Man. During his technical education he came under the influence of Professor Ayrton at the Finsbury Technical College, Sir Oliver Lodge at Liverpool University, and Sir Ambrose Fleming at the University College, London. In the meantime he had started work with the United Telephone Company in London, at the age of sixteen. By 1896 he was in charge of the company's activities in Ireland and, six years later, he was recalled to London to become engineer-in-chief at a difficult time in the company's history. All his qualities of leadership were needed to achieve the aim of developing the maximum service efficiency by 1911, when it was known that the company's franchise would expire.

When the G.P.O. took over the National Telephone Company's system in 1912, Frank Gill became a consultant and engineered telephone work in the U.S.A., Argentina, Brazil, Portugal, Turkey, and elsewhere. During the Great War he was controller of the Central Stores Department of the Ministry of Munitions. From 1919 to 1928 he was European Chief Engineer of the International Western Electric Company, which later became the International Standard Electric Corporation, and was responsible for establishing the Spanish telephone system, a service for which he was awarded the Spanish Royal Order of Isabel la Catolica. Another of Sir Frank's tasks was that of modernising the telephone system of the



SIR FRANK GILL

Shanghai Telephone Company. This work was one of the many services to China which earned him the award of the Brilliant Star with special rosette.

In 1922 he was elected President of the Institution of Electrical Engineers, and his Presidential Address outlined a scheme for an international telephone network, which inspired the formation in 1924 of the International Consultative Committee on Long-Distance Telephony (C.C.I.F.), a body which has been mainly responsible for the establishment of European long-distance communication.

Up to the time of his death Sir Frank was chairman of a number of companies, including Standard Telephones and Cables, Ltd., the International Marine Radio Company, Ltd., and Creed and Co., Ltd. He was a member of the Institution of Civil Engineers, an honorary member of the Institution of Electrical Engineers and a member of the Royal Institution. Despite the demands made by his professional and commercial activities, he found time to serve for five years on an advisory council to the Archbishop of Canterbury and to act as a director of the British and Foreign Bible Society.

Literature

Steam and Gas Turbines. By BERNHARDT G. A. SKROTZKI and WILLIAM A. VOPAT. London: The McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 40s. 6d.

MECHANICS and others employed in the operation and maintenance of turbine machinery are likely to find this book much more to their taste than the usual treatises designed for the class-room student. The practical nature of its contents is assured by the fact that Mr. Skrotzki is Associate Editor of our American contemporary, *Power*, his fellow author being a Professor at the Cooper Union School of Engineering in the State of New York. It is written throughout in an easy, and often almost a colloquial style: it is free from mathematics and is copiously illustrated. Eight of its nine chapters are concerned almost exclusively with steam turbines and their auxiliary machinery. After a simple explanation of the impulse and reaction principles, more than a score of commercial types of turbine are illustrated and briefly described. These include a number of pass-out machines, but the single-cylinder duplex exhaust turbine, well-known in this country, is not mentioned, and another notable omission is the Ljungstrom turbine. The principal constructional details employed by leading American manufacturers, which are illustrated in the next chapter, do not strike one as being in advance of British practice, while in some instances, such as the design of a main governor valve for a large reaction machine, they might be thought to be definitely behind it. Lubrication matters, such as the reconditioning of turbine oil, the lay-out of typical oil systems for governing and lubrication, the specification of oil for various duties, are next dealt with and much good advice is given concerning the starting and maintenance of lubrication systems. This leads, naturally, to the larger question of the operation and maintenance of the turbine itself, including the detailed procedure for starting and stopping and the points needing attention during overhauls.

The subject-matter, so far, has been essentially practical, but, under the heading of "Steam Fundamentals," the authors endeavour to convey some idea of the thermodynamics of nozzles and blading in language suitable for the class of reader for whom the book is intended. In an effort to achieve simplicity they have explained that the reactive force of a steam-jet is equal to its "unbalanced force" and have illustrated their argument by a picture of a cubical box supplied with high pressure steam, which escapes as a jet from a convergent nozzle in one of the sidewalls. With steam at 120 lb per square inch and a nozzle area of 1 square inch, the reactive pressure on the box is said to be 120 lb. This may seem plausible, but it is unfortunately altogether wrong. The reactive force is due, of course, to the change of momentum of the steam, and a simple calculation will show that it could not, even theoretically, exceed about 76 lb in the case considered. On the other hand, it might be far greater than 120 lb if the same nozzle were extended by a divergent mouth from which the steam was discharged into a good vacuum. Apart from the error mentioned, the matter is instructive and leads on to a consideration of the effect of various steam conditions and thermal cycles on the performance of turbines. Governing is given a chapter to itself, which covers the arrangements used for mixed pressure and pass-out turbines as well as for straightforward power station machines. The governing of open and closed cycle gas turbines is also illustrated diagrammatically. Further reference to gas turbines is deferred to the final chapter of the book, which follows a discussion of condensing plant, feed heaters, pumps and other power station auxiliaries. There are said to be over fifty gas turbines already running in various countries, not counting the large number employed to drive aircraft. The chapter on gas turbines constitutes more than one-fifth of the whole book and provides a useful introduction to the subject, as well as a summary of practice up to date.

Vibrations Due to Blasting and their Effects on Building Structures

By G. MORRIS*

No. II—(*Continued from page 395, October 27th.*)

AN alternative approach is to use $Ad/\sqrt{E}$ as a site factor; if it lies in the range 80–150, the site may be considered as having normal transmitting properties, if it lies appreciably below 80, the site has poor transmitting properties, and a more generous use of explosives is possible. If the site factor is greater than 150, special caution is required.

Experience shows that a high site factor is usually to be found on sites of wet clay or above coal workings. The majority of complaints of building damage are associated with this type of site. Where an outcrop passes across a site it is sometimes found that the factor is quite different on the two sides of the outcrop.

Vibrograms taken on turf or lightly consolidated soil are not a trustworthy indication of the amplitude of vibration of the rock below, but extensive tests demonstrate that the horizontal motion of the ground floor of a building is the same as that of the ground on which its foundation rests. It is therefore preferable, whenever possible, that tests should be made actually in the building which may be the subject of a complaint.

The greatest care is required when shots are fired in water, since strong vibrations may be set up in the surrounding ground. If a shot is fired near a bank, it is a wise precaution to measure the distance, not from the actual shotpoint, but from the bank nearest the structure under investigation.

(h) *Frequency of Vibration.*—The frequency with which the earth at a particular site vibrates appears to be a function of the local geological formation; it is not apparently affected by the magnitude or nature of the explosive charge generating it.

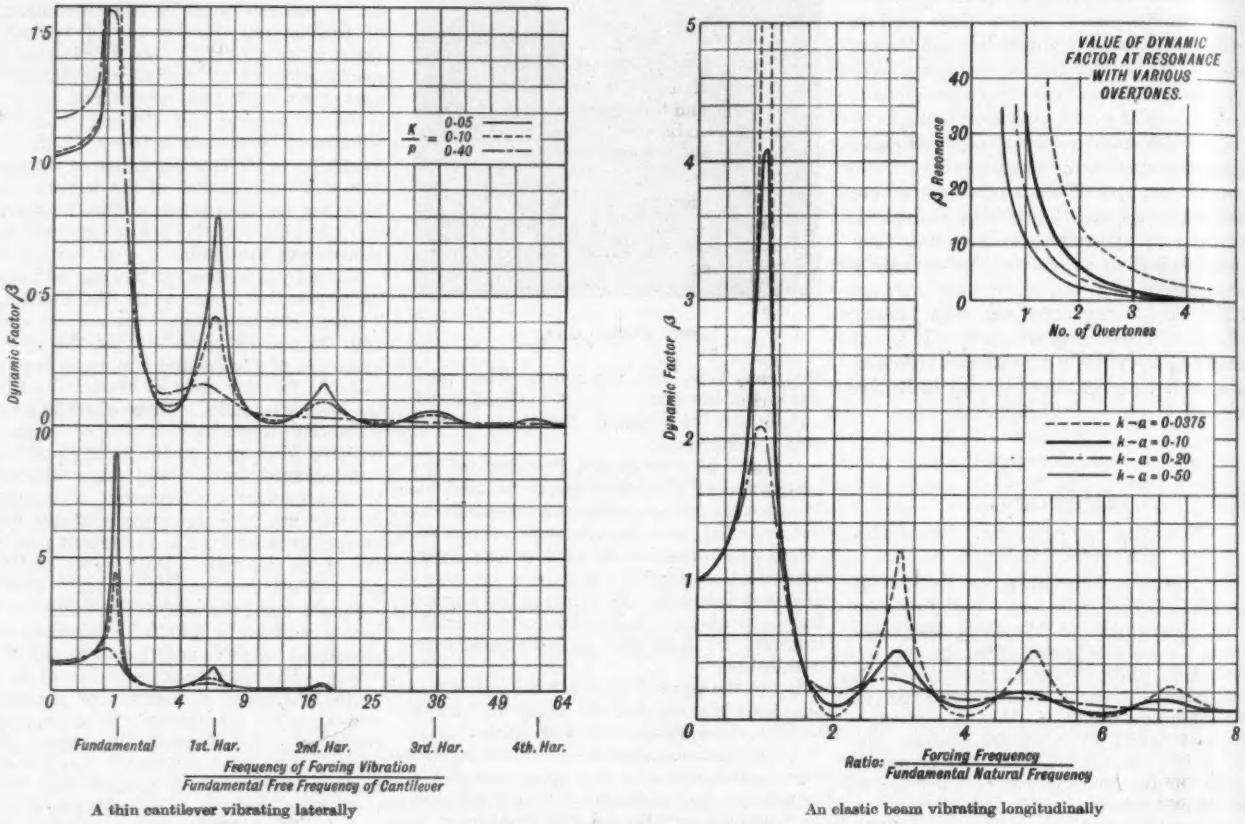
For a site on boulder clay the average frequencies of fifteen shots were: 21·2, 17·5, 21·2, 19·3, 21·4, 20·5, 19·1, 23·7, 23·7, 19·5, 19·7, 18·9, 18·0, 17·0 and 17·3 c/s. Although no general rule can be formulated, it is usually found that for moderate distances between shotpoint and vibrograph, say, up to 500 yards for average commercial blasting operations, the ground vibrates with a principal frequency characteristic of the site, but at larger distances the frequency becomes much smaller and at great distances the vibration becomes indistinguishable from that due to an earthquake. The high-frequency band is from 10–25 c/s and the low-frequency band from 3–10 c/s. The frequency of ground vibration is the same whatever the exciting cause. Angenheister and Schneider[10] and Mallock[11] found 20 and 15 c/s for railway trains, the Building Research Board[12] 15 to 28 c/s for a lorry over an obstruction, and Hyde and Lintern[13] 20 to 40 c/s for road traffic.

Seismologists are of the opinion that the low-frequency components of a blast are to be ascribed to transmission through the surface layers of the ground, the "ground roll" of the geophysicist. It is known that this surface disturbance is propagated more easily than a body wave and this will account for the preponderance of low-frequency energy at larger distances.

Many vibrograms show several frequencies characteristic of the site. It is usually found in practice that the main frequency is the only one responsible for the effective forces in a building structure.

It is of interest to note that the frequency of vibrations is not constant along a vibrogram so that the building up of resonance is markedly reduced. A number of vibrograms have been examined and it was found that the standard deviation of frequency expressed as a fraction of the mean lay between 0·08–0·33 with a weighted mean of 0·23.

(i) *Duration of the Vibration.*—An examination of Fig. 4 (page 395) shows that the ground vibration dies away rapidly after attaining its maximum value. The decision as to the time at which vibration ceases is difficult, but it is important to be able to estimate this. Analysis of records shows no effect with type or quality of explosive, with distance, or with the kind of ground, but that the number of vibrations executed is roughly constant. Seventy of the author's vibrograms showed a duration of $10 \pm 4 \cdot 4$ cycles. American data yielded a similar result with 14 cycles. The fall of amplitude is roughly exponential, i.e., of the form $A = A_0 e^{-Kt} \sin pt$. The effect of K is that of a damping factor, although this interpretation is not physically correct; K is conveniently called the "pseudo-damping" and is shown by tests to be proportional to the frequency. For a large number of tests of shots in limestone with different explosives, K varied from 0·44–0·81 with a mean of 0·60 times the frequency of the ground vibration.



FIGS. 7 AND 8—VARIATION OF DYNAMIC FACTOR

PART II.—THE EFFECT OF GROUND VIBRATIONS ON BUILDINGS

(1) *Direct Measurement of the Quantity of Explosive Needed to Damage Buildings.*—Many writers[14] have described blasting operations near buildings, but in only one case was damage caused to a building which

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was certainly due to the effects of the explosion. Thoenen, Windes and Ireland[2] attacked an old frame farmhouse, but found that a charge of 195 lb of explosive at a distance of 100ft only caused a little cracking of old plaster, while 150 lb at 93ft just cracked new ceiling plaster. The amplitude of vibration was 0·09in at 10 c/s. These workers have examined in detail the behaviour of thirteen domestic buildings when blasts were fired in neighbouring quarries and when the building was shaken by a mechanicalvibrator. In no case was damage caused by the blasting shot, and the mechanical shaking tests indicated a damaging limit of $1 \cdot 0\,g$ applied horizontally. On the basis of this work it has now become American practice to use a ground acceleration equal to $1\,g$ as corresponding to the threshold of building damage, and tables giving ground amplitudes corresponding to this acceleration are quoted by writers on the subject.[4,15]

In view of the small amount of evidence on which the criterion is based, the writer is of the opinion that many dwelling-houses would be very severely shaken by a vibration having acceleration of $1\,g$, and that, even if no damage to the structure could be found, the Courts might reasonably hold that the nuisance to the occupants was excessive. It may be noted here that the Americans consider all accelerations above $0 \cdot 1\,g$ as calling for caution and study.

It may be pointed out that it has been held to be no defence in law against a claim of building damage by ground vibration that the property was in bad repair before the blasting started.[16]

Use of model building structures in laboratory experiments is, at first sight, most attractive, but unfortunately the requirements of dynamic similarity between model and full-scale structure are difficult to attain.[17] The materials available for model making are very different from the traditional building materials, and it seems to be impossible adequately to represent traditional building techniques in models.

(2) *The Application of Earthquake Damage Studies.*—Major earthquakes generally cause considerable building damage of characteristic types and seismologists usually estimate the magnitude of earth motion in an earthquake from the reports of witnesses and the damage wrought.

A number of scales of damage have been published, the most widely used of which is the Rossi-Forel.[18] Many seismologists[19] have evaluated the maximum acceleration corresponding to each of the steps of the earthquake scale; these are in substantial agreement. The seismologist usually assumes that the vibration of the ground is sinusoidal of constant amplitude and frequency and that buildings can be treated as rigid bodies. Such a rigid body firmly fixed to the ground which executes simple harmonic motion of amplitude $H \sin pt$ will experience a force of magnitude $p^2H \sin pt$ times the mass of the structure acting through its centre of gravity. The problem of assessing the effect of ground motion due to blasting would thus appear to be solved by computing the acceleration, $H(2\pi n)^2$, where n is the frequency of the ground vibration in cycles per second and the damage should be that of the corresponding degree of the Rossi-Forel scale. It is found, however, that no such relation applies. For example, blasting-generated ground vibration of maximum amplitude 4×10^{-3}in at a frequency of 20 c/s is hardly more than felt as it passes and is quite incapable of producing the slightest damage to a building structure, yet it has an acceleration of 1588mm/sec² and falls into degree 9 of the Rossi-Forel scale, corresponding to "total destruction of buildings."

This lack of agreement has led previous workers to the conclusion that the acceleration of the ground cannot be used as a measure of the damaging properties of the earth waves from blasting and to adopt other criteria, e.g., Rockwell[3] used the velocity of the vibration, Thoenen and Windes[2] suggested the rate of change of acceleration with time, and Schulz and Rossiger[5] adopt $2\pi H$.

The discrepancy is due (*a*) to the fact that ground vibration from blasting is constant in neither amplitude nor frequency and (*b*) to the fact that buildings cannot be regarded as rigid structures to vibrations of the order of frequency associated with nearby blasting.

(3) *Theoretical Treatment.*—Since the practical expedients discussed above have failed, a theoretical treatment of the forced vibration of buildings is found to be of value, although it can only be applied accurately to a very limited range of real buildings. Static strength calculations are only possible in detail for some classes of buildings, e.g., steel-frame buildings, bridges and factory chimneys. The classes for which dynamic strength calculations are possible are even more limited, being restricted at present to thin beams and to simple panels. The former type only will be treated in this paper and the results applied to tall-frame buildings and isolated piers.

In the following treatment attention will be concentrated on the production of cracking in the actual wall structure, cement joints in brickwork or concrete. Plaster varies so widely in strength that no quantitative estimate of the vibration necessary to cause minor damage to ceilings is possible. In general, the ground amplitudes estimated by the methods of this paper will restrict the risk of ceiling damage to a negligible quantity. The material of the structure is assumed to have the same elastic modulus in tension and compression. This is obviously true for steel, and with timber the difference in the two values is less than the variation from specimen to specimen of the same lot. It is also permissible for unreinforced concrete and for brickwork, provided that the argument is limited to cases in which tensile forces do not occur. Every brick structure is loaded at any section by the weight of that part of the structure above it, so that the effect of vibration is to increase and decrease an existing compression stress and the use of the modulus applicable to compression is permissible, provided that no tensile forces develop. When this occurs a new stress distribution appears and the treatment given in this section is no longer applicable.

Vertical vibrations causing longitudinal forced vibration will first be considered. For a bar of isotropic elastic substance, of which height is at least four times the length, shearing stresses can be neglected for the small strains considered here.

If the ground motion can be represented by the continuous sinusoidal disturbance $H \sin pt$, the effective force, for a rigid beam, is equal to an inertia force of magnitude $\frac{W}{g}p^2H \sin pt$ acting through the centre of gravity.

On the usual assumption that the joints of brickwork have no tensile strength, the pier will theoretically fail when the maximum upward force due to the ground motion is just equal to the weight of the building acting downwards, i.e., when $p^2H=g$. Alternatively, for a material such as timber or steel, the stress per unit area is equal to Wp^2H/Ag, and the building will suffer damage when this is equal to the tensile strength of the material.

In the same way to find the static strength of a similar beam due to horizontal motion of its base when the latter is given a horizontal acceleration $p^2H \sin pt$, the maximum stress will be the same as that caused by a horizontal force of magnitude $\frac{W}{g}p^2H$ acting through the centre of gravity. This will cause a maximum bending moment $\frac{WH}{g}\frac{Lp^2}{2}$ $=M$ at the base and the stress will be greatest at the edges of the beam, tensile $\frac{M}{I}\frac{b}{2}$ on the side to which the force is applied and a crushing stress of the same magnitude in the opposite side, when I is the modulus of the section and b is the breadth in the direction of travel of the vibrations.

As in the consideration of the effects of vertical vibrations, the possibility of crushing of the brickwork can be ignored, and it is only necessary to consider the tension side. The least form of damage which a building can suffer is represented by the condition in which the brickwork just opens and so allows cracking of the pointing. This does not constitute serious damage to the fabric, but is convenient to use in calculating the limiting values of the stresses which can safely be applied.

This opening occurs when the tensile force just balances the loading $\frac{W}{A}$ due to the weight of the structure, where A is the bearing area—that is, when $\frac{bL}{4I} \cdot \frac{W}{g}p^2H=\frac{W}{A}$, or $f=\frac{4I}{bLA}$. For a solid pier $I=\frac{b^3a}{12}$, while $A=ab$, so that the critical value of f for a rigid pier subjected to a continuous vibration would be $\frac{b}{3L}$.

The dynamic stresses in a vertical fixed-free beam due to horizontal motion of its base $He^{-Kt} \sin pt$, which has been shown in Part I to be a good approximation to actual ground motion caused by blasting, have been made by Born and Pugh[20] at the author's request, and a similar treatment for a thin beam in longitudinal vibration has been made by the author. The solution of Born and Pugh contains, as a complete treatment must, two parts, one representing the forced vibration and one the associated free vibration of the cantilever. The omission of internal damping in the treatment of Born and Pugh overemphasises the effects of such free vibration.

Examination of many vibrograms obtained in buildings has failed to show any major effect due to free vibration of the structure, from which it may be deduced that the damping of the structure is of the same order as the pseudo-damping of the ground motion.

It is convenient to relate the dynamic stress in the structure to the more readily calculated static stress for a given displacing force by a dynamic factor which is the ratio of the dynamic stress to the static stress which would correspond to the same maximum ground motion infinitely slowly applied. It is found that this dynamic factor can be calculated in a form explicitly independent of the size of the beam and of the strength of its material of construction, being related to the ratio of the forcing frequency to the free frequencies of the structure. The values of the dynamic factor β given by Born and Pugh have been extended by calculation for a further range of values of the pseudo-damping and are shown in Fig. 7, while similar values for vertical vibration are given in Fig. 8. The treatment of the base of the cantilever

as fixed, i.e., it neither rotates nor slips in the ground, is justified by the work of Creskoff[17] and the experiment of Brötz.[22].

Inspection of Figs. 7 and 8 shows that the dynamic factor β is equal to one at very small frequencies, then as the fundamental free frequency of the beam is approached, rises to a peak, the maximum value of which depends on the pseudo damping. After the resonant frequency is passed β falls rapidly in value until it reaches a minimum not very different from zero. Thereafter it rises to a second peak at the frequency of the first harmonic, but this peak is very much smaller than that associated with the fundamental. After this the mean value of β is quite small with a series of peaks of rapidly decreasing maximum value corresponding to the higher modes of free oscillation.

This behaviour of β explains the dilemma of those who have endeavoured to apply earthquake studies to ground vibration due to blasting. The frequency of motion in an earthquake is usually less than the free frequency of the building, so that β will be of the order of unity. The ground waves due to blasting, on the other hand, are of considerably higher frequency than the building.

When the exact frequencies of free vibration of a structure are known and when the frequency distribution in the ground motion due to a proposed blast can be predicted with certainty, the appropriate value of β can be used in an exact calculation. Usually, however, the available information does not permit this to be done. The procedure suggested is then to assume that the frequency of the ground motion will be such that resonance with one of the natural frequencies of the building will take place and to use the peak value of β appropriate to that resonance. This assumption that resonance will take place introduces an explicit factor of safety into the calculation of the weight of explosive which may be used in a given blast.

The values of β graphed in Fig. 7 require correction on two counts. First, the mathematical treatment does not include internal damping of the structure, which will necessarily reduce the peak value at resonance. The direct introduction of a damping term into the mathematical treatments makes the expressions quite intractable. An approximate correction is presented in an Appendix.

The dynamic factor also requires correction for the fact that the calculations have assumed a constant frequency of ground motion, while it has been shown above that the frequency of ground motion generated by blasting is not constant, but varies in a random manner about a mean value. If the dynamic response of the forced structure is known analytically and the ground motion is also exactly known, it is theoretically possible to calculate the response of any part of the structure, but the labour involved would be prohibitive. In order to assess an approximate correction to be applied to the resonance peaks of Fig. 7 the mean value of β over the range from 0·75–1·25 of the resonant frequency has been found by graphical integration.

The recommended values of β for resonance in the horizontal motion of a slender beam have been obtained by multiplying the mean values from Fig. 7 with k=0·10 by 0·60 to correct for internal friction in the beam,* giving the following values :—

	Relative frequency	β
Fundamental	1·00	1·77
First harmonic	6·29	0·17
Second harmonic ...	17·44	0·031
Third harmonic ...	34·4	0·012

Turning to the effects of vertical ground motion, the natural frequency of most structures in longitudinal vibration is much higher than the frequency of the ground motion caused by blasting operations.

The natural frequency of a beam in longitudinal vibration is independent of the area of cross section and is equal to the velocity of sound in the material divided by four times the length of the beam. For steel the velocity of sound is about 16,000ft per second, so that, for a structure 50ft high, the natural frequency would be 80 c/s, and since the greatest frequency found in ground blasting vibrations is 30 c/s, the appropriate dynamic factor would be only 1·1 and the simple calculation for a rigid structure would apply. Similarly, for timber the velocity of sound is about 12,000ft per second, so that, for a 50ft structure, the natural frequency would be 60 c/s and again the dynamic factor will be nearly unity.

Since, however, the static strength indicates the need for the ground acceleration to exceed g before any damage is caused, buildings are much stronger against vertical vibration than they are against horizontal ground motion.

For brickwork an interesting position arises. For bricks in cement mortar Young's modulus is about 2×10^6 lb per square inch[23] and the density 112 lb per cubic foot, so that the velocity of sound is about 9000ft per second, and the natural frequency of a 50ft pier would be 45 c/s, and an argument similar to that above would apply. If, however, we consider a pier of brickwork in non-hydraulic lime mortar the value of Young's modulus is only 10^5 lb per square inch, the velocity of sound is about 2000ft per second, and a tall chimney, say, 80ft high, might have a natural frequency only 6 c/s, and Fig. 8 would indicate the possibility of resonance. This will not occur, however, for the following reason: the mathematical equation on which Fig. 8 is based is the resultant of two wave trains, one travelling up the beam and the second its reflection from the top; these combine to form a stationary disturbance in the beam. Now, a longitudinal wave is partially reflected at every discontinuity it passes and calculation indicates that up to half the amplitude of such a wave will be reflected at every bed of mortar, so that the stationary disturbance found will be much less than would be the case for a uniform beam having the same elastic constants. In this circumstance a dynamic factor of unity will give results sufficiently accurate for practical calculations.

(4) *Application to a Specific Structure.*—if a building structure, for which the dynamic properties could be calculated, was threatened with damage from a proposed blasting operation, the full procedure to evaluate the hazard involved would be :

(*a*) A bore-hole would be drilled at a point where the blasting is to take place, and in this would be fired a charge of explosive calculated to give a horizontal ground movement at the base of the building of the order of 1 or 2×10^{-3}in.

The motion of the building due to the firing of this shot would be recorded and the frequencies of the ground motion, the site factor and the pseudo-damping would be evaluated.

(*b*) The natural frequency and its harmonics and the damping of the structure would then be found either by calculation or by the use of a mechanically driven vibrator and a vibrograph.

(*c*) The appropriate dynamic factors would be found from these free frequencies and the frequency of the explosion generated waves using Fig. 7.

(*d*) The static critical acceleration which will cause any selected type of damage to the structure could then be calculated from its dimensions and the strength of its materials. The values so obtained would be multiplied by the dynamic factor obtained in (*c*), leading to a series of critical values of ground amplitude from which the maximum permissible weight of explosive to be fired at one time could be calculated from the results of the pilot shot using the square root law. Prudence would suggest the inclusion in the calculations of appropriate factors of safety similar to those used in ordinary design.

It is realised that even if it were possible, a procedure such as that set out in the above section would be very costly. In practice it is almost always impossible. A similar procedure can, however, be used with approximations for the unknown quantities, but it must be realised that each such estimate will involve the use of another "factor of ignorance," so that the estimated permissible quantity of explosive will be less than that which could actually be used.

(5) *A General Rule for Assessing the Limiting Permissible Weight of Explosives.*—In practice, the problem as passed to the engineer is very much less precise. It concerns a building of typical unframed brick or stone construction with wood-framed roof and floors. In addition, when the building is actually the home of a potential litigant, only the most cursory examination to assess its construction and state of repair is possible. Sometimes even a decision has to be based on a letter or telephone conversation as to what quantity of explosive should be allowed to be fired until such time as a visit can be paid to the site for actual investigation. On the one hand, the suggested charges of explosive must be small enough to make the possibility of building damage remote, and, at the same time, must be large enough to permit the site to be worked economically. In these circumstances, a general rule for assessing charge limits can be of most useful assistance. Such a rule is given in Fig. 9; the manner in which this was obtained is as follows.

A dwelling-house is so constructed that its strength relative to any definite disturbance cannot be calculated with any accuracy. Many of the joints, for example, the connection between walls and roof permit slip, and the bonds of brickwork and of plaster to walls and ceilings, are very variable, and, when the house has settled, usually contain cracks. Experimental work, now in hand by the Building Research Station [21] to measure the actual strength of complete dwellings, may provide very useful information on which more precise estimates may be based.

Members such as floors are traditionally designed to withstand the effects of moving loads as well as the static loading of furniture and the like. In order to withstand this, floors are usually built to give elastically under load, and movement as great as an inch may have to be tolerated in everyday use. This fact, combined with the high internal friction of traditional construction makes it most likely that floors and roofs will be much better able to tolerate forced vibration of short duration than will the main frame. This will bear a reasonable resemblance to a pier of high internal damping, although it is admittedly only a very rough approximation to consider the pier as slender. Until a better representation of the motion of such a frame in forced vibration is available, this must be accepted for lack of a better. There seems, however, to be no doubt that the walls, &c., of a building of however light construction, will be stronger

* See Appendix.

than the equivalent pier, so that the assumption of this equivalence will introduce a useful factor of safety.

In general, any structure will give a response curve of the same type as Figs. 7 and 8, and the use of resonant peak values in the calculation will introduce a factor of safety amply large to outweigh the errors introduced by the simplifying assumption of one set of β values applicable to all buildings.

The natural frequency in the fundamental mode and for the first three harmonics has been calculated for a family of piers of brickwork in lime mortar, with heights of 20ft, 30ft and 50ft with height-to-width ratios ranging from 4 to 15.

The formula used was $T=\frac{2\pi}{C^2}\frac{L^2}{b}\sqrt{\frac{12\rho}{Eg}}$.

L=length of beam.
b=width in direction of vibration.
ρ=density=112 lb per cubic foot.
E=Young's Modulus, 10^6 lb per square inch.
g=accn. of gravity=32·2ft/sec^2.
C=1·88, 4·69, 7·86 and 11·00 for the fundamental and first three harmonics.

The limiting static acceleration was obtained from $\frac{b}{L}g/3$, and the horizontal ground amplitude necessary just to cause cracking of the pointing, H_c, was calculated, using $\frac{b}{L}g/3 = \beta p^2 H_c$ with β as given on page 416. The results were tabulated and it was found that the smallest critical amplitudes were obtained with the shorter piers and with the higher harmonics. The smallest value tabulated was $8·2\times10^{-3}$in, the values ranging from this to as high as 0·65in. Thus, if the ground amplitude does not exceed $8·2\times10^{-3}$in, the possibility of damage even so small as the cracking of pointing will not occur for any of the family of piers considered. Since in every real case some yielding of the foundations of the pier would occur, the factor p^2 is overestimated if such yielding is neglected and thus leads to too small a value of H_c.

As described previously, a general rule for actual buildings cannot be calculated, but since isolated piers are weaker than real buildings, even domestic dwellings or farm buildings, the limiting amplitude of $8·2\times10^{-3}$in gives a conservative estimate of the limiting amplitude for conventional structures. The state of repair of the building does not seriously affect this estimate, as an old building technically less strong than a new one will have benefited by a process of "bedding in" due to long-continued small movements.

Every building is in a state of strain due to settlement and temperature variations, and this stress may add to or subtract from the strains induced by ground vibrations. This will to some extent offset the factors of safety detailed above, but in balance a considerable overall safety factor remains.

Using the empirical rule for ground amplitude, the required relation between distance and permissible quantity of explosive for a rock site is $8·2=\frac{110\sqrt{E}}{d}$ with E in pounds and d in feet, and for a wet clay site, $8·2=\frac{300\sqrt{E}}{d}$.

These quantities are graphed in Fig. 9. This rule is definitely conservative and, while it is applicable to buildings not belonging to the company responsible for the blasting operations and damage to which might form the subject of litigation, some greater degree of risk is permissible for structures owned by such a company, for which twice the amplitude—that is, four times the weight of explosives—can confidently be employed.

When the buildings are irreplaceable, such as churches and the like scheduled as ancient monuments, an initial reduction of the weight of explosives to 40 per cent of that given by the rule is recommended until experience of the effects of shotfiring can be obtained.

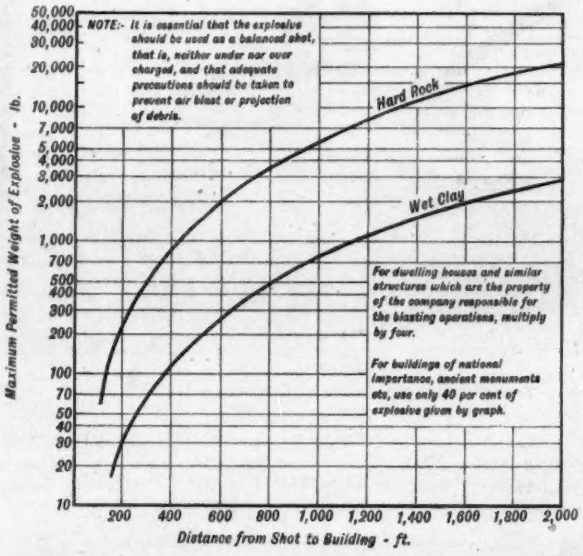

FIG 9—PERMITTED WEIGHT OF EXPLOSIVES AT VARIOUS DISTANCES FROM BUILDINGS

It will be noted that the graph does not extend to distances less than 100ft. In the author's experience, no blasting should ever be attempted less than 100ft from a building, unless the quantity of explosive is very small, without vibrograph records being obtained with pilot shots.

Insufficient cases of certain major damage due to blasting vibrations have been recorded so that the rule cannot be directly compared to allow the factors of safety to be actually assessed, but the rule is found to be reliable in field practice. An amplitude of building motion of 0·017in is sufficient to cause a nuisance to those living in the building subjected to a ground vibration of this amplitude.

It is interesting to compare the limiting motion allowed by the rule with the accepted American limit of an acceleration of 1 g, $8·2\times10^{-3}$in at 25·8 c/s, assuming sinusoidal motion of constant amplitude has an equivalent acceleration of 0·51 g, so that the effect of the larger charge permitted for buildings belonging to the quarry owner is in almost exact agreement with the American rule.

ACKNOWLEDGMENT

The author wishes to thank all those people who have provided opportunities for field studies in quarries and other blasting operations; those of his colleagues, particularly Dr. R. S. Silver and Mr. J. C. R. Cance, who have assisted in the taking of vibrograms, and Professor Max Born, for the stimulating discussions which led to the publication of his paper on dynamic factors.

APPENDIX

THE EFFECT OF INTERNAL FRICTION ON THE DYNAMIC FACTOR OF A BEAM IN LATERAL VIBRATION

The treatment of Born and Pugh[20] of the forced vibration of a fixed-free cantilever does not include the effect of internal damping in the structure. Attempts to include it produce a somewhat cumbersome solution in which the physical meaning of the equations is difficult to assess. In addition, while an average value for the pseudo-damping can be estimated with reasonable precision, the scanty available information concerning the internal damping of real buildings does not permit any great weight to be given to a numerical value. Suyehiro[25] has published some experimental values which indicate that α lies between $0·02p$ and $0·05p$. The Bureau of Mines have measured the damping coefficients of a number of domestic structures and find values of the same order, but the way in which their values are published does not permit α to be directly computed.

With damping coefficients of this magnitude the effect on the natural frequencies of a beam can in practice be ignored. The traditional calculations of the vibrations of bodies assume that every part vibrates sinusoidally, and if it is further assumed that the presence of a small degree of internal damping does not affect the shape in which the building vibrates, a rough but adequate guide to the correction of Born and Pugh's solution for the resonant peaks can be obtained by analogy by considering the resonance of a linear harmonic oscillation.

Although the standard textbooks deal extensively with the phenomenon of resonance, the rate at which the resonant amplitude is attained is not considered.

For a linear harmonic oscillator of undamped frequency and damping constant α forced by an exponentially decreasing vibration having an acceleration represented by $Fe^{-Kt}\sin pt$ the equation of motion is

$$\ddot{x}+2\alpha\dot{x}+\omega^2x=Fe^{-Kt}\sin pt \quad . \quad (1)$$

It is assumed that the oscillator is initially at rest, so that at $t=0$, $x=0$ and $\dot{x}=0$.

The solution of equation (1) is

$$x=G\left[e^{-Kt}(\gamma\sin pt+p\cos pt) - pe^{-\alpha t}\left(\frac{\alpha-K+\gamma}{\beta}\sin\beta t+\cos\beta t\right)\right] \quad . \quad (2)$$

where

$$G=\frac{F}{2(\alpha-K)(\gamma^2+p^2)} \quad \beta=\sqrt{\omega^2-\alpha^2} \text{ and}$$
$$\gamma=\frac{\beta^2-p^2+(\alpha-K)^2}{2(\alpha-K)}.$$

In equation (2) the terms in p represent the forced vibration and those in β the free vibration which dies away according to $e^{-\alpha t}$.

When $p=\beta$ equation (2) reduces to

$$x_{res}=\frac{F}{2(\alpha-K)\left[\left(\frac{\alpha-K}{2}\right)^2+p^2\right]}\left[p(e^{-Kt}-e^{-\alpha t})\cos pt+\frac{\alpha-K}{2}(e^{-Kt}-3e^{-\alpha t})\sin pt\right] \quad . \quad (3)$$

With the ground vibrations due to blasting, K is not usually greater than $0·10p$ and α is of the order of $0·02\beta$, so that $(\alpha-K)$ can be neglected relative to p and equation (3) is nearly equal to

$$x_{res}=-\frac{F}{2(\alpha-K)p}(e^{-\alpha t}-e^{-Kt})\cos pt \quad . \quad (3a)$$

Since K^2 can be neglected relative to p^2,

ground motion of amplitude H would have an acceleration very nearly equal to $Hp^2e^{-Kt}\sin pt$, so that we may write p^2H for F and the maximum values of equation (3a) are in the ratio

$$\frac{x_{o\ res}}{H}=\frac{p}{2}\left(\frac{e^{-\alpha t}-e^{-Kt}}{\alpha-K}\right) \quad . \quad . \quad . \quad (4)$$

where x_o is the maximum amplitude ($x=x_o\cos pt$).

In the case of a forcing vibration of constant amplitude $K=0$ and equation (4) reduces to

$$\frac{x_{o\ res}}{H}=-\frac{p}{2}\left(\frac{1-e^{-\alpha t}}{\alpha}\right) \quad . \quad . \quad . \quad (4a)$$

and the amplitude approaches its resonant value exponentially, the limit being governed by α.

Similarly, when there is no internal damping of the structure, the case considered by Born and Pugh, $\alpha=0$ and

$$\frac{x_{o\ res}}{H}=-\frac{p}{2}\left(\frac{1-e^{-Kt}}{K}\right) \quad . \quad . \quad (4b)$$

the approach again being exponential. Here, although the ground motion dies away, the undamped free vibration maintains the resonant response.

When $\alpha=K$ equation (4) cannot immediately be evaluated. It can, however, be found by expanding the exponentials into series

$$\frac{e^{-\alpha t}-e^{-Kt}}{\alpha-K}=-(t-(K+\alpha)t^2+(K^2+K\alpha+\alpha^2)t^3$$

&c.,

so that if $K=\alpha$

$$\frac{x_{o\ res}}{H}=\frac{p}{2}(t-2Kt^2+3K^2t^3, \&c.) \quad . \quad (4c)$$

and if

$$\alpha=K=0, \frac{x_{o\ res}}{H}=\frac{pt}{2} \quad . \quad . \quad . \quad (4d)$$

a result obtained very much more simply by Timoshenko[24].

The forced part of the bending moment dynamic factor of Born and Pugh is $\beta^1e^{-Kt}\sin(pt+\phi)$, where β^1 is the quantity graphed in Fig. 6. Now, at resonance ϕ is nearly equal to $\pi/2$, so that the dynamic factor is nearly equal to $\beta^1e^{-Kt}\cos pt$.

The forced part of equation (2), neglecting terms in K/p, is equal to $x_f=\frac{p}{2K}e^{-Kt}\cos pt$.

But the solution for resonant peaks is given in equation (4), so that the correction to β required to allow for the internal damping of the structure is obtained by analogy as

$$\beta^1e^{-Kt}\cos pt\times\frac{p}{2}\left(\frac{e^{-\alpha t}-e^{-Kt}}{\alpha-K}\right)\Big/pe^{-Kt}\cos pt/2K$$

$$=\beta^1\frac{K}{\alpha-K}(e^{-\alpha t}-e^{-Kt}) \quad . \quad . \quad . \quad (5)$$

It is readily shown that equation (5) has a maximum value at $t_m=\frac{\log_e K/\alpha}{(K-\alpha)}$.

Since K and α are both proportional to the frequency, they can be written as $K=kp$ and $\alpha=ap$. When the peak value of equation (5) is obtained from

$$\beta\frac{k}{a-k}(e^{-apt_m}-e^{-kpt_m}) \quad . \quad . \quad (5a)$$

Now $pt_m=\frac{\log k/a}{k-a}$ which is independent of p

so that equation (5a) is also independent of p and depends solely on the values of k and a.

Calculation shows that the effect of internal damping of the order found in buildings ($\alpha=0\cdot02p$) and the average pseudo-damping of real sites ($K=0\cdot10p$) can be allowed for to an accuracy sufficient for the present purpose by using a dynamic factor of $0\cdot6\beta^1$.

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Royal Ordnance Factory, Barnbow, Leeds

FOR the first time since the war the Ministry of Supply recently invited members of the world Press to tour a Royal Ordnance factory and to see the complete manufacture and assembly of the "Centurion" tank. This tank is claimed to be one of the largest and most heavily armoured vehicles known to be in quantity production in Britain.

The site at Barnbow, Leeds, was acquired in 1939 for the manufacture of guns, but the factory was later converted to a tank arsenal, and in 1947 the first "Centurion" tank was

FIG. 1—THE "CENTURION" TANK ON TEST

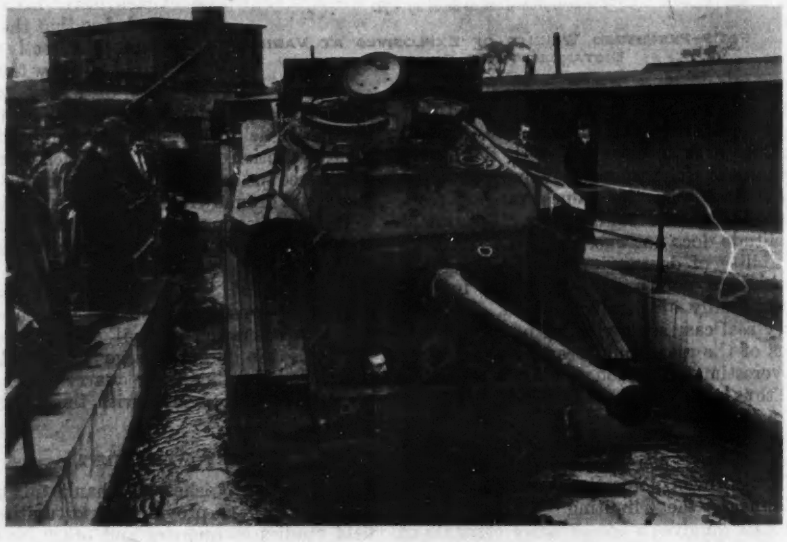

FIG. 2—TANK ABOUT TO WADE ON TEST

produced. In this factory the lines are laid down and equipped with specially developed machines and jigs, &c., to give a smooth production flow, the maximum degree of interchangeability of parts in process and to eliminate the necessity for fitting on the assembly lines. The "Centurion," which is illustrated

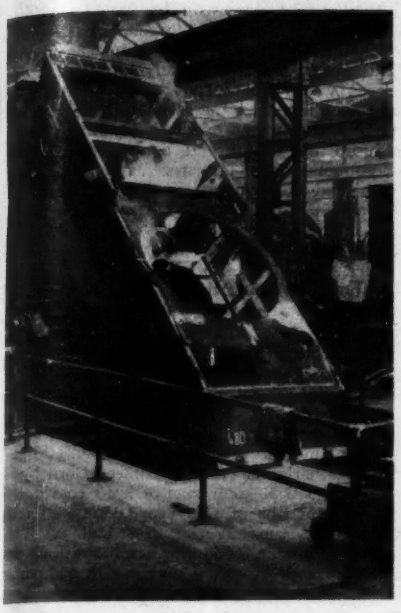

FIG. 3—A UNIVERSAL MANIPULATOR JIG

opposite, weighs 50 tons and is fitted with a 3·7in calibre gun firing a 20 lb shell. The modified Rolls-Royce Merlin engine develops 635 b.h.p. at a governed engine speed of 2550 r.p.m. and gives the vehicle a continuous cruising speed of about 25 m.p.h. The tank can also wade at depths of over 4ft 6in. A gearbox of the "Merritt and Brown" design is

FIG. 4—PART OF FINAL ASSEMBLY LINE

fitted which has straight spur gears providing five forward and two reverse speeds. Integral with the gearbox is a steering unit which enables the sprocket drive wheels to rotate contrawise when required. Housed externally with the drive sprockets is a final two-stage straight spur reduction gear.

The factory is composed of three main buildings. In the East shop all plate fabricating is done for the hull and primary sub-assemblies. The 3½in thick armour plating from which practically the whole of the tank is fabricated is a nickel-chrome-molybdenum steel, 80/90 tons tensile, with 3 per cent manganese. The component plates of the hull are cut out to finished sizes with profile burning equipment using carburetted water-gas. In this process the local temperature of the metal is raised to its fusion point and separation is obtained by blowing with a pressure jet of oxygen. The hull plates are then assembled with tack welds and attached to one of two kinds of rotating jigs, as illustrated. Each of these jigs is designed to manipulate the hull so that any joint can be presented to the welder in a horizontal downhand position, so obviating angle welding. In aligning a weld in this way so that the electrode is always applied vertically downwards a greater weld amperage can be used without the danger of undercutting and fewer runs need be made for the same depth of fillet. All welding is by hand, using stainless steel electrodes. Very stringent welding inspection is carried out during these heavy welding operations. Any hull assembly exhibiting clearances greater than $\frac{1}{16}$in prior to welding is rejected.

The turret is comprised of a single steel casting weighing 8½ tons. After the casting has been carefully set up and marked out, the gun mounting trunnions and the bottom face on which it will finally turn are machined. These machined faces thereafter serve as the fixed datum for all other machining operations. For drilling the radial holes on the top plate of the turret and elsewhere the pillar and arm of a conventional radial drilling machine is bolted to the turret casting on the production line. A boring machine of 14ft capacity is used to prepare the base of the turret for the spur rack, and the racer rings which house the 1½in diameter ball bearings upon which the turret rotates are flame hardened after machining. The hull facing strips for the sprocket drive reduction housing are machined from a horizontal boring arm fitted with a double negative rake cutter. The hull and the turret, along with some minor sub-assemblies, are then transferred on tracks to the middle building, which contains the main machine shop and the final tank assembly line running the length of the shop, as illustrated. Also in this shop the sprocket reduction gear, buffer and recoil equipment, suspension equipment, turret and gun are machined or built up. The twelve-wheeled independent suspension system consists of horizontal concentric coil springs with Newton and Bennet shock absorbers, used only late in the action. As the hull proceeds down the assembly line, these major components, along with the engine and gearbox, are bolted on or secured to studs previously welded to the hull. At the far end of the line the 14in tracks are fitted, the assembled turret is mounted, and finally the tank is driven out.

An Electrical System Protection Meeting

ENGINEERS from a number of countries attended a demonstration given, towards the end of September, by Brown Boveri & Co., Ltd., Baden, to show recent progress in the design of circuit breakers and protective devices for high voltage transmission systems. Technical interest was centred mainly on demonstrations illustrating the leading characteristics of a new range of air-blast high-speed circuit breakers for outdoor use. In particular the visitors were shown a 400kV circuit breaker (single-pole) unit operating with reclosure on arcing faults and dead short circuits. All the circuit breakers in the range are built up of a number, depending on the voltage, of identical arc extinction units arranged in series and shunted where necessary by resistance and capacitance units to give increased rupturing capacity and improved voltage distribution. A subsequent excursion to Lavey hydro-electric station near St. Maurice on the Rhone provided the opportunity of seeing the new switchgear in service. This station, which is owned and operated by the Lausanne City Electricity Supply operates with an available head of 40m and there is provision in the underground turbine hall for three 29·4MVA generators, two of which are now in operation. The main 135kV and 60kV air-blast switchgear is installed out of doors alongside a building which houses the control room and the 10kV and 6·4kV air-blast switchgear.

The International Conference of Naval Architects and Marine Engineers

THE Institution of Naval Architects and the Institute of Marine Engineers, in association with the Institution of Engineers and Shipbuilders in Scotland and the North-East Coast Institution of Engineers and Shipbuilders are arranging to hold an International Conference of Naval Architects and Marine Engineers during the Festival of Britain in 1951. The dates of the Conference are June 25th to June 30th in London, July 2nd to July 4th at Glasgow, and July 4th to July 6th at Newcastle upon Tyne. A provisional programme has been arranged including official receptions, luncheons, dinners, and the following papers are to be read :—

"Ship Structures : A Century of Progress," by R. B. Shepheard ; "Ship Motions," by John C. Niedermair ; "Proposed Design for a Special Research and Training (and ultimately Cargo) Ship," by Professor Ir. H. E. Jaeger and Ir. J. C. Arkenbout Schokker ; "Some Aspects of Pre-Fabrication in Ship Construction," by Nils Eckerbom ; "U.S. Fleet Maintenance and Battle Damage Repairs in the Pacific during World War II," by Captain Ralph K. James, U.S.N.; "Boiler and Turbine Testing," by Captain (E.) L. F. Ingram, R.N.; "Higher Steam Conditions for Ships' Machinery," by Mark L. Ireland, H. W. Semar, and N. L. Mocher ; "Marine Fuel Oils," by M. Blanchier ; "Stresses in Propellers and Propeller Shafting under Service Conditions," by S. F. Dorey, D.Sc., F.R.S.

THE ENGINEERS' GUILD.—Owing to the pressure of professional and private business, Mr. W. A. M. Allan, M.I.C.E., has felt compelled to relinquish the honorary secretaryship of the Engineers' Guild, an appointment which he has held for the past eleven years. Mr. J. H. W. Turner, A.M.I.C.E., a member of the Council since 1946, has been appointed to succeed Mr. Allan.

INDUSTRIAL FILMS.—Shell-Mex and B.P., Ltd., has recently added two new sound films to the service which it operates primarily for all who are associated with and interested in mechanised agriculture. One of them is entitled "Diesel on the Farm," and presents an effective study of the fuel pump and injection system, emphasising clearly the importance of cleanliness in maintenance and fuel storage. The other film is "Scrapbook No. 2," which includes some excellent shots of work on reclaiming marginal land in Scotland.

Industrial and Labour Notes

Wages and Prices

An article contributed to *Man and Metal*, the official journal of the Iron and Steel Trades Confederation, by Mr. Lincoln Evans, the general secretary of the Confederation, raises once again some of the factors relating to wages and prices, which face both sides of industry to-day.

Mr. Evans says that with prices rising as they are, it is impossible to expect that the present level of wages can remain stationary and that new wage claims can be avoided. What matters, he claims, is not that new demands are being made but the extent to which a sense of responsibility is displayed by the unions in pressing them. "Only on the assumption," Mr. Evans declares, "that unions will act responsibly has the argument that wages should be settled through our democratic and voluntary systems of bargaining any validity at all." Those who cry out for a wages policy, the article continues, seem to have in mind some kind of central wages authority, though "we never get to the point where we are told how such an authority, if established, would operate, or how particular claims would be judged, or what yardstick would be applied."

But, Mr. Evans asserts, to expect the unions to try and keep wages stationary while the cost of living is increasing is to ask something from them that would destroy their effectiveness and seriously damage their influence for good and "would be an open invitation to all kinds of unofficial activities." In any event, he adds, restraint as a permanent thing is not the answer to our economic problem. The answer is higher productivity, because the standard of life that any nation can sustain depends in the last resort on the level of its productivity. "It is certainly a moot point," Mr. Evans claims, "whether this country can afford a much higher standard of life out of the total goods and services we are now producing." That is why, he argues, in the final analysis, productivity is really a more important issue than wage restraint.

Wage Incentive Schemes

At the quarterly meeting of the National Joint Advisory Council, held on Wednesday of last week, under the chairmanship of the Minister of Labour, one of the matters considered was the inclusion of a chapter in the Industrial Relations Handbook dealing with wage incentive schemes. Material on the subject, which has been examined by a committee of the Council, was approved.

The Ministry of Labour has made an investigation in recent months into the number of industrial establishments in the United Kingdom in which wage incentive schemes are in operation. The results of that investigation are surveyed in the latest issue of the *Ministry of Labour Gazette*, and show that of the total of about 57,500 establishments approached on the matter, nearly 51,000 provided the information asked for. At approximately 15,500, or 30 per cent, of those 51,000 establishments, wage incentive schemes were in operation for some or all of the employees at the end of April last. It should be explained that the employers were asked to state whether they operated, for all or part of their employees, a wage incentive scheme, other than straight piece rates, designed to encourage increased productivity. The employers, it may be added, were not asked to state the number of workers to whom the schemes applied, nor were they asked to distinguish between the different types of wage incentive schemes.

A statistical statement on the Ministry's survey reveals some interesting features. In the group of industries classified as "Engineering, Shipbuilding and Electrical Goods," there were 5101 establishments which replied to the inquiry. Of that number, 2502 or 49 per cent, intimated that they were working wage incentive schemes (other than straight piecework), and 2599 said that they had not instituted such schemes.

Changes in Wage Rates

Changes in wage rates, reported to the Ministry of Labour as having come into operation in September, resulted in an aggregate increase of £75,000 in the weekly full-time wages of approximately 432,000 workpeople in the United Kingdom, and in a small decrease in the weekly wages of about 2000 workpeople. Those affected by the increase included certain workers in gas undertakings, in beet sugar manufacture, and lower paid workers employed by British Railways and London Transport. The decreases recorded took effect under sliding scale arrangements, based on the index of retail prices.

According to information published by the Ministry of Labour, in the first nine completed months of this year there was a net increase of £590,700 in the weekly full-time wages of 3,235,000 workpeople. In the corresponding period of last year, 4,714,000 workpeople received an aggregate increase of £814,100 in their weekly wages. The index of rates of wages (June 30, 1947=100) has remained at 110 for all workers throughout this year. For men however it increased one point, to 110, in September, the first change recorded since December, 1949.

Wages in the Coal Mining Industry

A recent award of the National Reference Tribunal imposed upon the Joint National Negotiating Committee for the coal mining industry, the duty of framing a scheme for the distribution of the global sum of £3,500,000 a year to the lower paid workers. The negotiating committee, of course, consists of representatives of the National Coal Board and the National Union of Mineworkers.

In making its award, the Tribunal laid down some general principles, which may be summarised as follows: the preservation of differentials to some extent; the avoidance of anomalies and repercussions "as far as possible"; an increase in the minimum wage, and an increase in the day-wage rates up to a certain ceiling, beyond which the increase would not operate. On Thursday of last week the Joint Negotiating Committee reached a settlement on the method of applying the award. As these notes go to press the actual details of that settlement have not been revealed. A special delegate conference of the National Union of Mineworkers at York, yesterday (Thursday), was expected to approve them in their final form.

Coal Production

Coal output from the deep mines of Great Britain has recently kept above the 4,000,000 tons a week level. Figures issued by the Ministry of Fuel and Power show that in the week ended October 28th, saleable output from deep mines was 4,117,700 tons, to which was added 257,900 tons from opencast workings, making a total for the week of 4,375,600 tons. Total production, deep-mined and opencast, in the first forty-three weeks of this year was, according to the Ministry's figures, 177,979,200 tons, compared with 176,212,300 tons in the corresponding period of 1949. But colliery manpower continues to decline and in the week ended October 21st there were 687,200 workers on the books, compared with 709,500 at the same time last year.

Coal stocks in this country have been giving some concern, and last week, in a written Parliamentary reply, the Minister of Fuel and Power, Mr. Noel-Baker, admitted that in recent weeks the output of deep-mined coal had been less than the estimate that had been made and that the opencast output had been reduced by heavy and continued rain. In consequence the Minister explained, stocks at the end of October were expected to be about 15,750,000 tons, to which must be added about 300,000 tons, which, as the result of the summer prices schemes, were now in consumers' cellars instead of in coal merchants' stocks. He thought that at the end of October stocks would be short of the target by about 400,000 tons.

Meanwhile, the United Nations' Economic Commission for Europe has made some observations on European coal production, saying that "it is rising but not enough." According to the Commission, six European countries—United Kingdom, Belgium, France/Saar, Italy, The Netherlands, and Western Germany—produced 287,250,000 tons of hard coal in the first six months of this year, compared with 279,500,000 tons in the first half of 1949. The Commission adds the comment that the general trend towards a decrease in manpower in the mines appears to continue, but claims that it is still compensated to a great degree by an increase in output per manshift.

A Staffordshire Cement Works

The Minister of Town and Country Planning has given permission for the erection of a cement works at Cauldon Low, near Cheadle, Staffordshire. The conditions attaching to this permission are that the Local Planning Authority or the Minister shall be satisfied with the detailed plans of the buildings, that plant shall be installed for arresting dust, that the chimney shall not be more than 250ft high, and that there shall be a suitable tree-planting and landscape scheme for the area.

It is explained by the Ministry of Town and Country Planning that, although the site chosen for the works is near the proposed Peak National Park, it is in a hollow and therefore largely screened from the surrounding country. The need for cement in the industrial towns of the district is urgent, as at present supplies have to be sent from the south of England.

Scarce Raw Materials

The executive committee of the Organisation for European Economic Co-operation has been reviewing raw material shortages, which may result from the existing international situation, and has directed the "vertical committees" of the Organisation to undertake an immediate study of the position. The commodities to be reviewed at once include coke and coking coal; scrap, iron ore, manganese and certain finished steel products; copper, zinc, tin and aluminium; fibres, sulphur, rubber and raw materials for the production of synthetic rubber; timber and pulp and cement.

The various O.E.E.C. committees concerned will endeavour to establish the present statistical position of the materials for which they are responsible. It is intended also to survey the position of other commodities, which might lead to bottlenecks in industrial production. Later on these committees will hold another series of meetings to determine what action is necessary and possible to deal with the situation revealed by their investigations. A report is to be prepared which will enable the executive committee of O.E.E.C. to present an overall picture to the Council of Ministers on November 24th.